A STUDY ON FEASIBILITY OF LAPAROSCOPIC INGUINAL HERNIA REPAIR IN A DISTRICT HOSPITAL (SULTAN ABDUL HALIM, SUNGAI PETANI)

BY

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1) ABSTRAKS

Tajuk : Kajian tentang fisibiliti melakukan pembedahan laparoskopik inguinal di hospital daerah (Hospital Sultan Abdul Halim, Sungai Petani).

Latar Belakang : Walaupun pembedahan hernia biasa dilakukan akan tetapi pembedahan terhadap hernia bilateral dan ulangan boleh menjadi rumit. Pembedahan yang dilakukan mempunyai risiko untuk morbiditi dan peningkatan kos. Walaupun pembedahan laparoskopik mempunyai kos kapital yang tinggi tetapi memberi kesan yang lebih baik, oleh itu feasibiliti pembedahan ini di hospital daerah akan dikaji.

Objektif Kajian : Tujuan kajian adalah untuk membandingkan keberkesanan kos dalam pembedahan laparoskopik berbanding pembedahan secara kaedah terbuka. Selain dari itu, jangka masa pesakit di dalam wad serta jangka masa pembedahan turut dikaji. Komplikasi yang timbul juga akan dicatatkan.

Jenis Kajian : Kajian perbandingan retrospektif di antara pembedahan laparoskopi dan pembedahan secara terbuka.

Keputusan : Kesemua jumlah pesakit adalah 155 orang. Terdapat 84 pesakit dalam pembedahan laparoskopi dan 71 pesakit dalam pembedahan secara terbuka.

Pembedahan laparoskopi meliputi 53 kes bilateral, 19 kes ulangan di sebelah kanan dan 12 kes ulangan di sebelah kiri. Pembedahan laparoscopic TEP dilakukan untuk 53 orang pesakit, manakala 31 pesakit kaedah TAPP. Kes secara terbuka pula meliputi 48 kes bilateral, 15 kes ulangan di sebelah kanan dan 8 kes ulangan di sebelah kiri. Hanya 3 pesakit perempuan terlibat di dalam kajian. Masyarakat Melayu mendominasi dengan jumlah 75 %. Jangka masa pesakit di dalam wad selepas pembedahan adalah 34 jam untuk pembedahan terbuka dan 25 jam untuk pembedahan laparoskopik ($p = 0.002$). Jumlah kos keseluruhan kes terbuka pula adalah lebih rendah (Rm 194.50) berbanding laparoskopik (Rm 417.35). Signifikasinya adalah $p = <0.000$. Jangka masa pembedahan pula lebih panjang dalam kaedah terbuka berbanding kaedah laparoskopik ($p = 0.034$). Kadar penukaran teknik pembedahan dari laparoskopik kepada terbuka adalah 6.45 %. Manakala, kadar penukaran teknik TEP kepada TAPP adalah 4 % sahaja. Tiada komplikasi besar dicatat.

Rumusan : Fisibiliti kaedah pembedahan laparoskopi adalah terbukti untuk kes hernia bilateral dan ulangan walaupun di hospital daerah atau hospital bukan rujukan. Walaubagaimanapun, kajian yang menyeluruh dan teratur diperlukan.

2) ABSTRACT

Topic : A study on feasibility of laparoscopic inguinal hernia repair in a district hospital (Hospital Sultan Abdul Halim, Sungai Petani).

Background: Even though hernia repair is a very common general surgical procedure, repairing bilateral and recurrent inguinal hernia always give problems to the surgeon. The operation performed have higher tendency towards cost increment and morbidity. With the relatively higher capital cost but good outcomes, we decided to study the feasibility of performing laparoscopic inguinal hernia repair in a district hospital setting.

Objective: The study objective is to compare the cost effectiveness of laparoscopic versus open inguinal hernia surgery. Besides that, we would like to determine the duration of post operative hospital stay and operative time usage of laparoscopic surgery. In addition, we would like to identify the complications of both operative techniques.

Design: Retrospective analysis of laparoscopic and open technique in bilateral and recurrent inguinal hernia.

Results: The total numbers of patients were 155. Laparoscopic surgery consisted of 84 patients. 53 cases were bilateral, 19 cases were right recurrent and 12 cases were left recurrent. TEP was performed in 53 cases and 31 cases of TAPP. In open technique, 48 cases were bilateral, 15 cases were right recurrent and 8 were left recurrent. Only 3 female noted and Malay were predominant (73 %). The mean duration of post operative hospital stay was 34 hours in open and 25 hours in laparoscopic surgery ($p = 0.002$). The mean hospitalization cost of open (RM 194.50) is cheaper than laparoscopy (RM 417.35). The different was significant as $p = < 0.000$. The mean operative time is longer in open repair ($p = 0.034$). The conversion of laparoscopy to open was 6.45 %. Conversion of TEP to TAPP was 4 % only. No major complications noted.

Conclusion: It is feasible to perform laparoscopic surgery for recurrent and bilateral inguinal hernia in district or non referral centre. However, well designed study is indicated.

1.0 INTRODUCTION

Each year about 600,000 hernia repair operations are performed in the United States. Until 1990, all were performed as traditional, "open" procedures requiring a large incision in the lower abdomen. The result was significant pain for patients. Besides that, it comprises about 7 % of all surgical outpatient visit (Sir Alfred Cushieri, 2002) . Recurrent inguinal hernia accounts for 10-15% of inguinal hernia repairs, yet the most appropriate treatment remains controversial. Bilateral inguinal hernia accounts up to 10 % of total inguinal hernia (Kumar *et al.*, 1999). In Hospital Sultan Abdul Halim, Sungai Petani, about 200 to 250 of inguinal hernia operations were performed each year.

Today, minimally access technique of laparoscopic surgery can be used to repair inguinal hernia. Although both traditional and laparoscopic hernia surgery can be performed as an outpatient basis, patients treated laparoscopically seem to experience more rapid healing and far less pain during recovery. Kerthikesalingam et. al, reported that laparoscopic surgery significantly shortened the time taken to return to working activities. Kald et. al in his study of 100 patients post laparoscopic recurrent inguinal repair stated that the median interval off work was 7 days (0-52) and the median time of full recovery was 21 days.

Laparoscopic repair of recurrent and bilateral inguinal hernia is becoming increasingly accepted in the surgical practice either using an extraperitoneal or transabdominal approach for the placement of mesh.

Previous literature reflects that efforts to perform open mesh repair for recurrent inguinal hernia often results in further recurrent. Besides that, other complications include chronic pain, seroma, hematoma, bleeding, injury to the vas deferance, increase risk of wound infection and other internal organ injury (F. Charles Brunicardi, 2010). An economic evaluation of laparoscopic versus open inguinal hernia repair study by Kate et al in 1996 stated that laparoscopic hernia repair appears to be an expensive option in most cases. Pertaining to the total cost, laparoscopic inguinal repair was 2.2 times expensive compared to open inguinal hernia repair (Kate Lawrence, 1996). Most of the cost results from the disposable instruments used in laparoscopic surgery (Kate Lawrence, 1996).

Comparing with a well established centre for laparoscopy where the instrument used were disposable, most of the instruments used in laparoscopic surgery in Hospital Sultan Abdul Halim were reusable and being used for several times [mean 6 times]. This will reduce the total cost of the laparoscopic surgery and will be studied in detail in this study. Besides that, the duration of hospital stay and operating time will also be studied in detail. Early recurrence after inguinal repair in both techniques will be determined as well as complications in both open and laparoscopic techniques.

2.0 LITERATURE REVIEW

2.1 History of Hernia Repair

Hernia is originally a Greek word of herhios which is meant as a bud or an offshoot. Hernia is also known as breuk in Dutch, rompure in French, keal in Greek and rupture in English. It was documented and recognized in the human being history from its very beginning even before century. During the initial period, the understanding of hernia and it's surgical role was restricted to the treatment of huge umbilical and inguinal hernias and life-threatening incarcerated hernias (M Mokete, 2001).

2.2 Evolution of Inguinal Hernia Repair

The treatment of inguinal hernia can be divided into five different evolving eras. The oldest epoch was during ancient time of the ancient Egyptiant till 15th century. The Egyptian Papyrus of Ebers contains quite a thorough description of hernia. It was described as a swelling that comes out during coughing and straining. However, most essential practical knowledge concerning hernias in ancient times derives from Galen. This knowledge was then spiced up with minor modifications during Middle Ages (Graham,2010).

Eventually in the Renaissance era, the second era of hernia treatment began. Herniology flourished mainly due to many new anatomical understanding and discoveries. In spite of many important discoveries and more practical knowledge about hernia in 18th to 19th century, the treatment and end results of it were still unsatisfactory. Patients still experienced multiple complications. Outcomes of the surgery were poor and patients were not satisfied with the surgery. Astley Cooper, an anatomist and surgeon stated that, no disease treated surgically involves so broad knowledge and skills as hernia as it has many variants and multiple presentations (Graham, 2010).

As surgical field developed, the introduction of anesthesia and antiseptic procedures constituted and played a big role in the beginning of modern hernia surgery known as era of hernia repair under tension in 19th to middle 20th century. Three principles rules of inguinal hernia surgery were introduced to the technique of inguinal hernia repair. It includes antiseptic and aseptic procedures, high ligation of hernia sac and narrowing of the internal inguinal ring (Weinstein and Roberts, 1975). Even though the progress and understanding of hernia improved, the treatment and surgical results were still poor. Recurrence rate at that time were reported up to 100% in 4 years duration and postoperative mortality can be up to 7% (Cowell, 1946).

The new development era only started to receive satisfaction in the surgery after Bassini implemented a brilliant idea of repair reconstructing the posterior wall of

the inguinal canal. E. Shouldice, a Canadian surgeon, created the next landmark in inguinal hernia surgery. He proposed a technique of imbrications of the transverse fascia and strengthening of the posterior wall of inguinal canal by four layers of fasciae and aponeuroses of oblique muscles. These modifications had successfully decreased the recurrence rate of inguinal hernia surgery to 3%. These had become the biggest victory in the era of hernia repair (Cowbey,2004).

The next discovery in the history of hernia surgery lasting up to the present days is referred to as era of tensionless hernia repair. The tension of sutured layers was initially reduced by doing an incision of the rectus abdominal muscle sheath. It was then modified as the understanding of the hernia pathophysiology improved by using foreign materials (Cowbey, 2004). The turning point in hernia surgery was the discovery of synthetic polymers by Carothers in 1935.

The first tensionless technique was described by Lichtenstein. It was based on the principles of strengthening the posterior wall of inguinal canal and reinforcing it with prosthetic material. Lichtenstein then published his data on 1,000 successful operations with Marlex mesh without any recurrence in 5 years after surgery. Thus fifth rule of groin hernia repair was introduces--tensionless repair (F. Charles Brunicardi, 2010) . Another treatment method was popularized by Rene Stoppa, he used Dacron mesh situated in the preperitoneal space without any fixation sutures. He started performing the operation in 1975, and reported recurrence rates of 1.4% (Palanivelu, 2008).

Table 2.2 : Milestone In Hernia Repair

Marcy (1871)	Publication of original paper on antiseptic herniorrhaphy ("A New Use of Carbolized Catgut Ligature")
Czerny (1876)	Described ligating and excising the indirect peritoneal sac through the external ring
Kocher	Twisted and suture-transfixed the peritoneal sac in the lateral muscles. through the external ring
MacEwen (1886)	Reefed the peritoneal sac into a plug to block the internal ring.
Lucas-Championniere	Opened the external oblique aponeurosis to expose the entire inguinal canal.

The evolution of the repair procedure was then improved with the introduction of sticking a synthetic plug into inguinal canal. Lichtenstein in 1968 used Marlex mesh plug (in shape of a cigarette) in the treatment of inguinal and femoral hernias. The mesh was fixed with only single suture. The next step was the introduction of a Prolene Hernia System which enabled repair of the tissue defect in three spaces: preperitoneal, above transverse fascia and inside inguinal canal. Laparoscopic treatment of groin hernias began in 20th century. The first laparoscopic procedure was performed by P. Fletcher in 1979. In 1990 Schultz plugged inguinal canal with polypropylene mesh. Later such methods like total abdominal preperitoneoplasty [TAPP] and totally extraperitoneal peritoneoplasty [TEP] were introduced. It has

the advantages of reducing the postoperative pain and early return back to daily activities. The disadvantages of laparoscopic approach were its high cost and risk connected with general anesthesia. The history of inguinal hernia repair evolved from life-saving procedures in case of incarcerated hernias to elective operations performed within the limits daycare surgery with minimal postoperative complication.

2.3 Father of Modern Hernia Repair

The contributions of many surgeons results in the tremendous development and improvement in the surgical hernia repair, but it was not until the late 19th century that hernia surgeon Edoardo Bassini comes with the idea of posterior wall repair. He was considered as the father of modern day hernia surgery .

Bassini's aggressive approach was to perform a definitive cure in the treatment of inguinal hernia. He presented a paper with the title of " a radical cure of inguinal hernia " to the Italian Surgical Society in Genoa, in 1887. He reported only 8 failures in 206 hernia repairs during a 3-year period. His results were monumentally important, considering that before his work, failure rates ranged between 30% and 40% in the first postoperative year and almost 100% after 4 years.

Bassini's operation epitomized the essential steps for an ideal of tissue repair. He described his operation by opening the external oblique aponeurosis through the external ring, then resected the cremasteric fascia to expose the spermatic cord. He then divided the canal's posterior wall to expose the preperitoneal space and did a high dissection and ligation of the peritoneal sac in the iliac fossa. Bassini then reconstructed the canal's posterior wall in 3 layers. He approximated the medial tissues, including the internal oblique muscle, transversus abdominus muscle and transversalis fascia to the shelving edge of the inguinal ligament with interrupted sutures. He then placed the cord against that newly constructed wall and closed the external oblique aponeurosis over it, thereby restoring the step-down effect of the canal and reforming the external inguinal ring at the same time (Graham, 2010).

There have been numerous modifications of Bassini's original technique, although many of the less detailed renditions have yielded poor results. Those that avoided opening the posterior wall, for example, resulted in suture-line tension between tissues at the most medial part of the inguinal canal just cephalad to the pubic bone. Some help was afforded the Bassini technique and other tissue repairs by the introduction of relaxing incisions by surgeons such as Wolfer, Halsted, Tanner and McVay.

2.4 Laparoscopic Era and Evolution

For decades, the principles of adequate surgical access and surgery on targeted organ were being practiced by all surgeons worldwide. The size of the incision or surgical approach to the target organ was hardly became an issue. In the initial face when Dr Kurt Semm, a gynaecologist did appendicectomy in1983, a major breakthrough happened. It was followed by an introduction of the miniature solid state camera. The lack of attention paid to laparoscopy by general surgeon was primarily due to perception that it was best as a diagnostic modality (Cowbey, 2004).

Soon after that, the idea of therapeutic surgery explored after Philippe Mouret of Lyon, France performed the first laparoscopic cholecystectomy in 1987. Since then, almost all abdominal surgery now can be performed laparoscopically (Palanivelu, 2008b). The extent of laparoscopy now included extra abdominal organ for example thyroid, adrenal, lung and etc.

Although open, tension-free repair and mesh based repair remains the standard procedure performed for inguinal hernia repair, laparoscopic herniorrhaphy in an experiance hands of surgeon can also produce excellent results comparable to those of open repair. As for comparison of open repair with laparoscopic (totally extraperitoneal patch) repair, Eklund et al found that 5 years postoperatively, 1.9%

of patients who had undergone laparoscopic repair continued to report moderate or severe pain compared with 3.5% of those in the open repair surgery.

Pertaining to the laparoscopic inguinal hernia repair, it has 3 commonly used methods which include transabdominal preperitoneal repair [TAPP], totally extraperitoneal repair [TEP] and less popular technique of intraperitoneal onlay mesh [IPOM] repair. The most commonly performed laparoscopic techniques are the TEP and TAPP repairs (Sherwinter, 2010).

2.5 Prosthesis in Inguinal Hernia Repair

2.5.1 Evolution of Prosthesis

As the knowledge, methods and outcomes of the inguinal hernia surgery improved tremendously, the requirement for a good and satisfactory prosthesis in hernia repair has been recognized, formulated and modified. In more than a century, various materials including patient's own tissue or autograft have been tried. The most successful autografts is fascia lata. It has been been used widely as suture material, a pedicle graft, and as a free transplanted graft. However, the disadvantages of autograft are the requirement of a second operation to harvest it. Besides that, fascia lata weakens and fails over time and dissolves in the presence of infection (Bloodgood, 1919).

After an extensive experimental studies and researches were done, an artificial prosthesis was then introduced into the markets. Attempt by attempt were then done to define the definite characteristics of the ideal prosthetic material for hernia repairs. Even though all these attempts to achieve definite "ideal prostheses" have met with varying degrees of success, there were no currently available prosthesis that are perfect or free of problems. The choice of material thus requires compromise and it is based on surgeon preferances. Surgeons however, do have the luxurious of choosing a large array of products from which they are comfortable with and satisfy the most (F. Charles Brunicardi, 2010).

2.5.2 Characteristics of an Ideal Prosthesis

The ideal characteristic of the prosthesis used in inguinal hernia repair surgery should include few specials characteristics. It should be long lasting without the ability of body to modify it physically whether through hydrolysis or denaturation within a short period of placement. It also should be chemically inert in the body and does not ignite and excite inflammatory or foreign body reaction. It is important for the materials to be non carcinogenic and not producing any allergy or hypersensitivity reaction (Cameron, 2006).

The material also should be capable of resisting the mechanical strain and capable of being fabricated in the form required, and constructed in a way such that sutures or cutting will not cause the mesh to unravel or fray. It should be sterile, permeable

and can allow tissue to grow in between it. Good material should be able to stimulate fibroblastic activity in order to allow incorporation into tissue rather than sequestration or encapsulation. Besides that, it should have the capacity of being sufficiently pliable so as not to cause stiffness and later on causing pain or to be felt by the patient after the repair. Examples of currently available prosthesis includes nylon, polyethylene, polyester, expanded polytetrafluoroethylene and much more (F. Charles Brunicardi, 2010).

Table 2.5.2 : Ideal Prosthetic Mesh

The ideal prosthetic mesh should:
Not be physically modified by tissue fluids
Be chemically inert
Not excite inflammatory or foreign body reaction
Be non carcinogenic
Not produce allergy or hypersensitivity

2.5.3 Complications Related to the Use of Prosthetics.

Materials composed of polypropylene and polyester insight a prompt and strong fibroblastic tissue response with minimal inflammation. This response consists of

macrophages and giant cells, most of which eventually disappear. Fibroblastic activity allows rapid integration of the prosthesis into tissues. However, contraction of the enveloping scar tissue creates undesirable deformation of unsecured pieces of the monofilament. These will result in curling of its free margin and later on its small pieces roll up. There also have been some reports in the literature regarding migration of the freeform and preformed prosthetic mesh products (J A Parra, 2004).

Besides that, serum or blood that accumulates in the dead spaces surrounding the prosthesis becomes an excellent media for the organism to grow. This condition will aggravate infection. Suction drainage can be use to eliminate dead space as well as to remove serum collections. However, an insertion of drain can become the source of ascending infection. Intestinal obstruction and fistula formation are serious complications and often require removal of the mesh or prosthesis. When a prosthesis is placed inside the peritoneal cavity, various degrees of visceral adhesions form depending upon the type of material used. When this is unavoidable, omentum or an absorbable prosthesis should be interposed between the mesh and the bowel (Chowbey, 2004).

Treatment of infection involves the application of basic surgical principles. Although most infections occur acutely, delayed infections involving non absorbable prostheses can occur months or years later. In the case of an acute infection of a groin hernia repair, it is advisable to quickly and widely open the

wound (including the subcutaneous layer down to the external oblique) to avoid chronic sinus formation. A specimen should be taken for culture and sensitivity. Besides that, irrigation and antibiotics should be started. The healing process should secondary intention. Dressing of the wound and monitoring are mandatory to allow healing (J A Parra, 2004).

If a prosthetic mesh had been used in the repair, it can usually be left in place if the above measures are employed promptly. If the wound closes, but a sinus continues to drain, it is likely that the mesh and all old suture material will need to be removed. Unlike early infection, when the mesh can be salvaged, late infection involving mesh requires the complete removal of the unincorporated material, although the incorporated mesh may be left undisturbed (Cameron, 2006).

Another complication that can be encounter by surgeon includes an inflammatory granuloma in the course of repairing a recurrent inguinal hernia. It is prudent to avoid using a new prosthesis. Gram staining of the inflammatory granuloma at the time of surgery is not sufficiently reliable to exclude subsequent infection. In most cases of persistent infection related to a prior prosthetic repair, multifilament and braided sutures, such as silk and cotton should be avoided to prevent further granuloma formation (Palanivelu, 2008).

3.0 ANATOMY AND TYPE OF INGUINAL HERNIA

3.1 ANATOMY OF OPEN HERNIA

3.1.1 Inguinal Canal

The inguinal canal is for the passage of the spermatic cord from the abdomen to the scrotal cavity. It would be unreasonable to have a single opening through the abdominal wall, as contents of the abdomen would prolapsed through it each time the intraabdominal pressure was raised. To prevent this, the route for passage must be sufficiently tight. This is achieved by passing through the inguinal canal, whose features allow the passage without prolapse under normal conditions (Sinnatamby, 2006).

The inguinal canal is approximately 4 cm long and is directed obliquely inferomedially through the inferior part of the anterolateral abdominal wall. The canal lies parallel and 2-4 cm superior to the medial half of the inguinal ligament. This ligament extends from the anterior superior iliac spine to the pubic tubercle. It is the lower free edge of the external oblique aponeurosis. The main occupant of the inguinal canal is the spermatic cord in males and the round ligament of the uterus in females. They are functionally and developmentally distinct structures that happen to occur in the same location. The canal also transmits the blood and

lymphatic vessels and the ilioinguinal nerve (L1 collateral) from the lumbar plexus forming within psoas major muscle (Sinnatamby, 2006).

The inguinal canal has openings at either end which is called the deep and superficial inguinal rings. The final anatomical relation to describe the inguinal canal is that of its anterior and posterior wall and finally its floor and roof. The anterior wall of the canal is formed mainly by the aponeurosis of the external oblique with the lateral part of the wall being reinforced by fibres of the internal oblique. The posterior wall is formed mainly by transversalis fascia with the medial part of the wall being reinforced by formation of the conjoint tendon also known as the inguinal falx, which is the merging of the pubic attachments of the internal oblique and transverse abdominal aponeurosis into a common tendon (Sinnatamby, 2006).

The iliopubic tract is the thickened inferior margin of the transversalis fascia that appears as a fibrous band running parallel and posterior to the inguinal ligament. The iliopubic tract contributes to the posterior wall of the inguinal canal as it bridges the external iliofemoral vessels from the iliopectineal arch to the superior pubic ramus. The roof of the inguinal canal is formed by the arching fibres of the internal oblique and transverse abdominal muscles. The floor is formed by the superior surface of the incurving inguinal ligament, which forms a shallow trough. It is reinforced in its most medial part by the lacunar ligament, a reflected part or

extension from the deep aspect of the inguinal ligament to the pectineal line of the superior pubic ramus (Sinnatamby, 2006)

3.1.2 Internal Inguinal Ring

The deep (internal) inguinal ring is the entrance to the inguinal canal. It is the site of an outpouching of the transversalis fascia. This is approximately 1.25 cm superior to the middle of the inguinal ligament and lateral to the inferior epigastric artery (from the external iliac artery). The deep inguinal ring is the beginning of an evagination in the transversalis fascia, forming an opening like the entrance to a cave, through which the vas deferens (or round ligament of the uterus in the female) and gonadal vessels pass to enter the inguinal canal. The transversalis fascia continues into the canal, forming the innermost covering (internal fascia) of the structures traversing the inguinal canal (Sinnatamby, 2006).

3.1.3 External Inguinal Ring

The superficial, or external inguinal ring is the exit from the inguinal canal. It is a slitlike opening between the diagonal fibres of the aponeurosis of the external oblique muscle, superolateral to the pubic tubercle, through which the spermatic cord or the round ligament of the uterus, emerge from the inguinal canal. The medial and lateral margins of the superficial ring formed by the split in the aponeurosis are called crura. The lateral crus is attached to the pubic tubercle and

the medial crus is attached to the pubic crest. Fibres arising from the inguinal ligament lateral to the superficial ring arch superolaterally to the superficial ring. These are known as intercrural fibres and help to prevent the crura from spreading apart – ie preventing the split in the aponeurosis from expanding – increasing the likelihood of prolapse. So the canal passes obliquely through the three anterior abdominal muscles. Each of the two described openings is protected by two of the anterior muscles (Sinnatamby, 2006).

The superficial ring is in the external oblique aponeurosis and is protected posteriorly by the conjoint tendon which is the amalgamation of the internal oblique and transverses abdominis. The deep ring is posterior to the aponeurotic fibres of external oblique and the muscular fibres of internal oblique. The deep and superficial inguinal rings in the adult do not overlap because of the oblique path of the inguinal canal. Consequently increases in intraabdominal pressure act on the inguinal canal, forcing the posterior wall of the canal against the anterior wall and strengthening this wall, thereby decreasing the likelihood of herniation until the pressures overcome the resistant effect of this mechanism. Furthermore, contraction of the external oblique approximates the anterior wall of the canal to the posterior wall. Contraction of the internal oblique and transverse abdominal muscles make the roof of the canal descend, constricting the canal (Graham,2010).

3.1.4 Content of Inguinal Canal

In the male it is the spermatic cord which is transmitted by the inguinal canal. It suspends the testis in the scrotum and contains the structures running to and from the testis. It begins at the deep inguinal ring lateral to the inferior epigastric artery, passes through the inguinal canal, exits the superficial inguinal ring and ends in the scrotum at the posterior border of the testis (Sinnatamby, 2006).

The spermatic cord has three distinct layers of fascia surrounding it. There is the internal spermatic fascia derived from the transversalis fascia, the cremasteric fascia derived from the fascia of both the superficial and deep surfaces of the internal oblique muscle, and the external spermatic fascia derived from the external oblique aponeurosis. The inguinal canal transmits all of the contents of the spermatic cord, which includes the vas deferens a 45 cm long muscular tube responsible for conveying sperm from the epididymis to the ejaculatory duct, the testicular artery arising from the aorta and supplying the testis and epididymis, the sympathetic nerve fibres on arteries and both autonomic fibres on the vas deferens, the genital branch of the genitofemoral nerve (L1,2) from the lumbar plexus, supplying the cremaster muscle and the lymphatic vessels draining the testis, passing to the lumbar lymph nodes.in female it consist of round ligament and its vascular supply as well as areolar tissues (Sinnatamby, 2006).

3.2 ANATOMY OF LAPAROSCOPIC HERNIA

3.2.1 Preperitoneal Space

Poor familiarity with the complex anatomy of the posterior inguinal view is an important contributor to the steepness of the laparoscopic inguinal hernia learning curve.

The preperitoneal space is contained between the transversalis fascia and the parietal peritoneum. It contains areolar and adipose tissue and the inferior epigastric artery and vein (Chowbey, 2004). Transabdominal laparoscopic landmarks useful when performing the TAPP repair are the obliterated fetal remnants, which divide the posterior surface of the anterior abdominal wall into 3 fossae. The median umbilical ligament is a remnant of the embryonic urachus. It forms the center divide by arising in the midline from the apex of the bladder toward the umbilicus. Laterally, the paired medial umbilical ligaments, vestiges of the fetal umbilical arteries, arise from the superior vesicle arteries toward the umbilicus. Between the median and medial ligaments lie the supravesical fossae, where external supravesical hernias occur. Most lateral are the paired lateral umbilical ligaments, which contain the inferior epigastric arteries. Between them and the medial ligaments lies the medial fossa, which contains the Hesselbach triangle, the zone of direct hernias. Lateral to the inferior epigastric arteries is the lateral fossa, which is

the site of indirect hernias. Thus, the lateral umbilical ligaments separate the lateral and medial fossae, and delineate between indirect and direct hernias, respectively (Sherwinter, 2010).

The following 3 landmarks found in the preperitoneal space are constant in their presence and location. They are a good starting point to get one's bearings in this difficult region. They are also helpful in cases of large hernias or recurrences (Sherwinter, 2010).

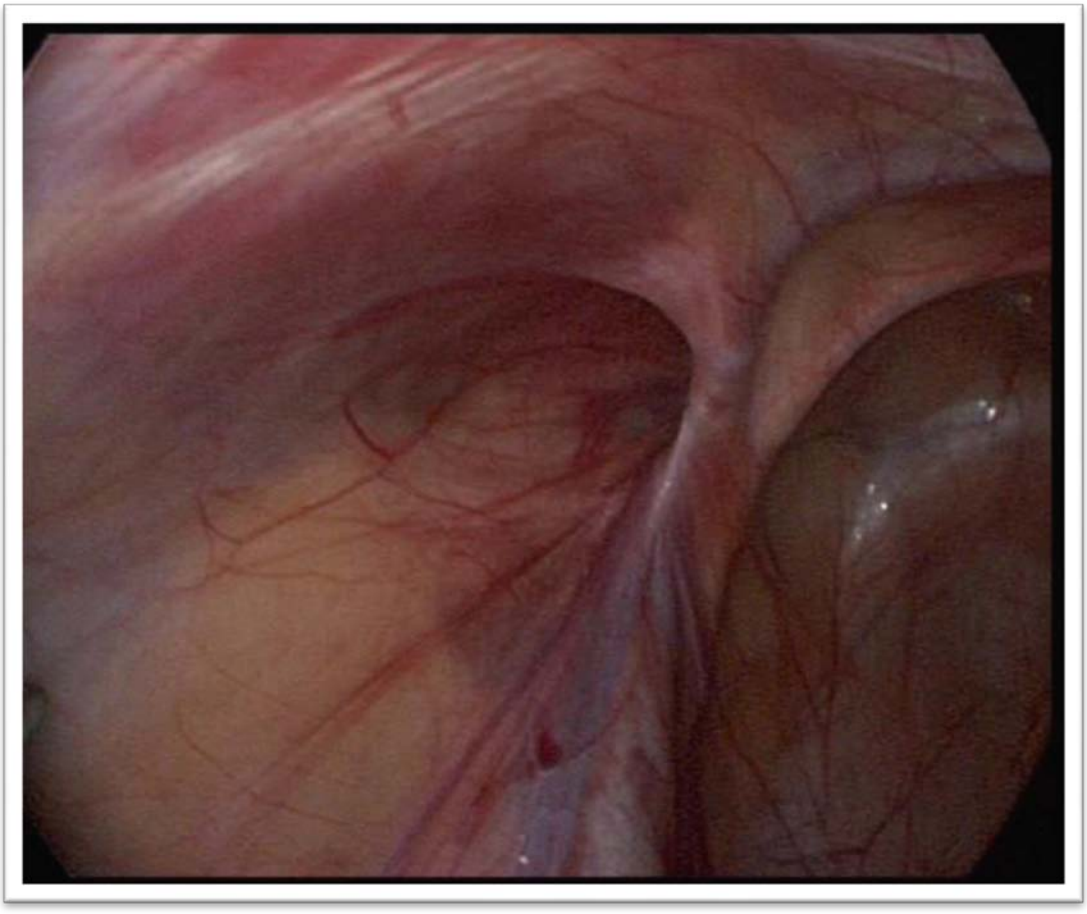

Figure 3.2 Inguinal anatomy from the laparoscopic viewpoint

3.2.2 The Inferior Epigastric Artery and Vein Complex

This complex lies on the rectus muscles bilaterally. Medial to these vessels but above the iliopubic tract is the external ring, which is not visible in patients without a direct hernia (Sherwinter, 2010).

3.2.3 The Internal Ring

It is situated lateral to the inferior epigastric artery and vein but is often obscured by them, even when a hernia is present. The location of the internal ring can be approximated by locating the junction of these vessels and the cord structures (Sherwinter, 2010).

3.2.4 The Femoral Ring

It is inferior and lateral to the external ring and lies below the iliopubic tract just medial to the external iliac vessels. The external iliac vessels change their name to the common femoral vessels after they pass beyond the inguinal ligament. Since preperitoneal hernia repair is performed dorsal to the inguinal ligament, these vessels still retain their intra-abdominal name (Sherwinter, 2010).

3.2.5 The Cooper ligament

This is the name given to the periosteum of the superior pubic ramus. The pubic ramus can be easily palpated with a blunt grasper and is an excellent starting point for dissection (Sherwinter, 2010).

3.2.6 The Iliopubic Tract

Another fundamental structure that deserves careful recognition is the iliopubic tract. It is commonly referred to as the shelving edge of the inguinal ligament in open surgery. This aponeurotic stretch of tissue is located posterior to the inguinal ligament and extends from the anterior superior iliac spine to the superior pubic ramus. As a continuation of the transverse abdominus aponeurosis and fascia at the upper border of the femoral sheath, it passes medially to form the inferior border of the internal inguinal ring, crossing over the femoral vessels.

3.2.7 The Triangle of Pain

Importantly, the iliopubic tract forms the superolateral border of the so-called "triangle of pain," an area bounded medially by the spermatic vessels (as shown in the image below). In this area, tacking of the mesh is to be avoided because of the risk of injury to the femoral branch of the genitofemoral nerve or the lateral femoral cutaneous nerve (Sherwinter, 2010).

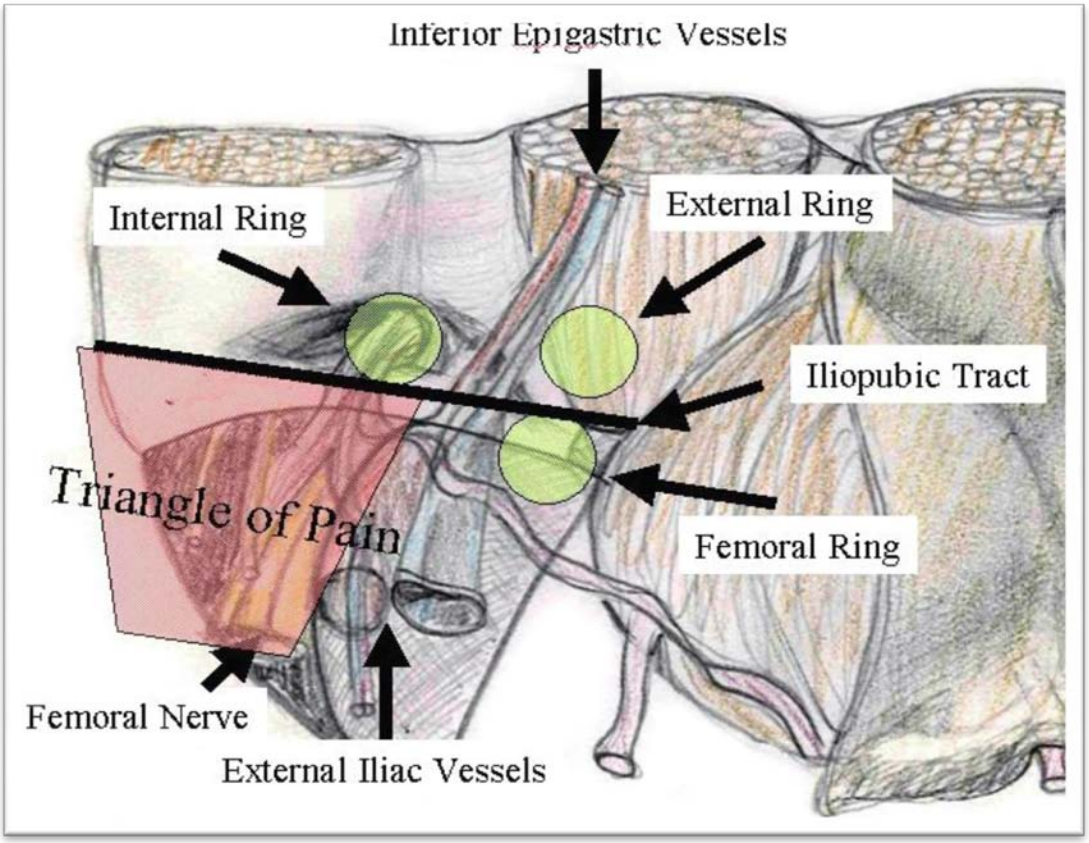

Figure 3.2.7 Triangle of Pain

3.2.8 The Triangle of Doom

Another anatomical zone that requires the surgeon's awareness is the so-called "triangle of doom," bordered medially by the ductus deferens, laterally by the