

A STUDY OF INGUINAL HERNIA REPAIR

Dissertation submitted to

THE TAMILNADU Dr. M. G. R MEDICAL UNIVERSITY, CHENNAI

With partial fulfilment of the regulations

For the award of the Degree of

M.S.(General Surgery)

Branch I



GOVERNMENT KILPAUK MEDICAL COLLEGE

CHENNAI

MARCH 2010

BONAFIDE CERTIFICATE

Certified that this dissertation is the bonafide work of **Dr.V.RAJENDRAN** on “**A STUDY OF INGUINAL HERNIA REPAIR**” during his M.S. (General Surgery) course from May 2007 to March 2010 at the Government Kilpauk Medical College and Government Royapettah Hospital, Chennai.

PROF.DR.S.UDAYAKUMAR, M.S
Professor & Head of Department
Surgery unit II incharge
Department of General Surgery
Govt. Kilpauk Medical College &
Govt. Royapettah hospital,
Chennai-600014

Prof.Dr.V.KANAGASABHAI, M.D.
Dean
Kilpauk Medical College Chennai-600010

ACKNOWLEDGEMENT

I take this opportunity to express my profound gratitude to **PROF DR.P.RAVI M.S.**, for allotting the topic and his constant guidance, suggestions and encouragement, till the time of his retirement, without which it could not have materialized.

I extend my gratitude to **PROF. S. UDAYA KUMAR M.S.** HOD Dept. of General Surgery. Govt. Royapettah Hospital, Kilpauk Medical College for his constant support and guidance since then.

I am grateful to our Assistant Professors **DR.M.V.UDAYA CHANDAR M.S.** and **DR.S.MANISELVI M.S.** for their valuable help, suggestions and encouragement.

I thank **THE SUPERINTENDENT**, Govt. Royapettah Hospital and **THE DEAN**, Kilpauk Medical College, for allowing me to use the hospital facilities during the period of study.

I express my sincere thanks to all my **patients** who in spite of their physical and mental sufferings have co operated and obliged to my study and request for regular follow up.

CONTENTS

Serial no	Chapter	Page no
I	Introduction	1
II	Aim of the study	2
III	Materials and methods	3
IV	Review of literature <ul style="list-style-type: none">• Historical review• Anatomy of inguinal canal• Types of inguinal hernia• Classification• Types of inguinal hernia repair• Complications of Inguinal hernia repair• Surgical procedures and techniques	5 9 13 16 19 25 36
V	Post operative follow-up	54
VI	Observations and results	56
VII	Discussion	63
VIII	Conclusion	68
IX	Annexure <ul style="list-style-type: none">• Master charts• References• Case proforma	

INTRODUCTION

Inguinal Hernia is one of the most common general surgical problems. It constitutes 75% all abdominal wall hernias. The male: female ratio is 7:1. Right side representation is more common than left side. Indirect type of hernia is more common than the direct in the ratio of 2:1. Congenital inguinal hernia is common in low birth weight individual with preponderance to right side. For an adult male the incidence increases steadily with age and has been reported to approach 50% over the age of 75. The treatment for Inguinal Hernia has been constantly evolving starting from the earliest surgery through scrotal incision to the present day laparoscopic preperitoneal mesh repair.

Some of the procedures commonly used are

1. Conventional repair by Bassini's procedure or one of its modifications.
2. Tension free onlay or inlay mesh repair technique.
3. Both inlay and onlay technique using Prolene or ultra pro hernia system
4. Laparoscopic preperitoneal repair – Transabdominal preperitoneal or Totally extraperitoneal approach.

The literature regarding this is also reviewed and discussed.

AIM OF THE STUDY

To evaluate the outcome of four techniques employed in inguinal hernia repair namely Darn repair, Lichtenstein repair, Prolene hernia system repair and laparoscopic groin hernia repair in the form of

1. Analgesic requirements
2. Seroma
3. Wound infection
4. Cord edema
5. Orchitis
6. Nerve entrapment and its sequelae
7. Recurrence

In patients who presented to the **Department of General Surgery, Govt Royapettah Hospital, Kilpauk Medical College , Chennai 600014.** from May 2007 to November 2009.

MATERIALS AND METHODS

STUDY GROUP

This study includes 217 hernias in 200 patients .All of whom presented with inguinal hernia to the Department of **General Surgery, Government Royapettah Hospital; Chennai 600014** .from may 2007 to November 2009

STUDY DESIGN

Prospective study

METHODS

- 40 patients with 41 hernias undergone hernia repair by darn method using 1.0 prolene
- 137 patients with 150 hernias undergone hernia repair by Lichtenstein method using 15x15 cm/7.5x12.5cm prolene mesh.
- 18 patients with 18 hernias undergone hernia repair by onlay and inlay technique using prolene hernia system.
- 6 patients with 8 hernias undergone laparoscopic hernia repair by TEP or TAPP using ultra pro mesh 15x15 cm.

INCLUSION CRITERIA

Both elective and emergency cases included in this study. Both male and female patients included in this study.

EXCLUSION CRITERIA

Patients under 18 years of age were excluded from the study.

INVESTIGATIONS

Apart from the routine investigations patients above 40years of age and those complaining of symptoms of prostatism were investigated for evidence of prostatic hypertrophy by digital rectal examination and ultra sonogram of the abdomen to determine the size of the prostate and assess for residual urine. Those patients with COPD were evaluated with pulmonary function tests and sputum AFB if necessary.

REVIEW OF LITERATURE

HISTORICAL REVIEW

The earliest record of Inguinal Hernia date back to approximately 1500BC. The term hernia is derived from a Greek word meaning Offshoot – Bulging. The Latin word hernia means rupture or tear. Trusses or bandage were generally used to cure the hernia. In the earlier part of the 1st century A.D the operation in vogue was described by **Celsus** through an incision in the neck of the scrotum. The hernial sac was dissected off the spermatic cord and transected at the external Inguinal ring. The testis as well the incision was generally left open.

Casper Stromary distinguished direct from indirect hernia in 1559 and advised that the testicle need not be removed during the operation done by Celsus. From the 18th century to early 19th century the anatomy of the Inguinal region was described and accurately defined. The dawn of modern surgery by the introduction of carbolic spray antiseptic by **Joseph Lister** in 1865 marked an important event in all surgeries including hernia surgery.

Marcy was the first to introduce antiseptic technique in hernia repair. He was also the first to recognize the importance of transversalis fascia and of closing the internal inguinal ring.

Lucas Championnere was the first to slit open the external oblique aponeurosis to reveal the canal which allowed dissection and ligation of the sac at the internal inguinal ring under direct vision. But all hernia repairs had a high mortality with recurrence rate of 30 – 40% in one year.

The greatest contribution of the hernia surgery was that of an Italian surgeon **Edoardo Bassini**. He had a clear insight into the anatomy and physiology of the inguinal region which enabled him to dissect and reconstruct the inguinal canal preserving the functional anatomy. He laid open the inguinal canal widely by splitting the external oblique aponeurosis. He next opened the transversalis fascia from the pubic tubercle to beyond the internal inguinal ring. Thus he was able to dissect and ligate the sac high in the retroperitoneal space. Realizing the importance of repairing the transversalis fascia he sutured the internal oblique and transverse abdominus muscle as well as the upper leaf of the transversalis fascia in one layer to the lower leaf of the transversalis fascia and the inguinal ligament.

Bassini first performed the operation in 1884 and reported in 1887. His cases had a very low recurrence rate and other complications. These phenomenal results earned him the title of “Father of Modern Herniorraphy”. During the next 100 years most inguinal hernias were repaired by Bassini’s method or one of its variations.

Important among them were

1. The multilayered repair of **Shouldice in 1953**
2. **In 1898 George Lothissen** first reported the technique of suturing the conjoint tendon to the Cooper's ligament (Pectineal)

The hernia repair done with undue tension is doomed to failure because of Ischaemic necrosis of the tissues caused by pressure of sutures under tension. The Bassini repair or its modification is suitable only for cases where the musculoaponeurotic arch is close to inguinal ligament to which it can be sutured without tension. When they are far away, tension inevitably occurs with the Bassini method or its modification and leads to failure.

To overcome this problem Darning was introduced. Earlier darning was done with natural materials like external oblique aponeurosis, fascial grafts from the thigh, strips of fascia lata, skin etc,. They were largely disappointing. Later silk was introduced but failed for obvious reasons. It was not until **Moloney** introduced the nylon darn technique in 1948 the results were satisfactory.

At about the same time patches were introduced in the form of sheets of natural tissues, biological material, metals, synthetic sheets to fill the gaps of weakened posterior wall.

Between 1900- 1909 **Witzel, Goepel, Bartlert** and **McGavin** used silver wire filigree sheets to fit the size and contours of the gaps and sutured the borders of the defect. However the wire corroded, fragmented and rejected through chronic sinuses. Tantalum metal sheets were introduced by **Burke** in 1940, tantalum gauze by **Throckmorton** in 1948. Then natural flaps like tissue of the thigh, external and internal oblique aponeurosis were used. Free grafts were also used.

No real progress were made until the development of modern polymer plastics in the form of woven or knitted mesh of polyamide and polypropylene. There were popularized by **Usher** in 1958. Later polyester and PTFE was also introduced. Today the mesh sheets of polypropylene and PTFE are widely practiced. Rolled up mesh plugs area also used extensively. Preperitoneal approach was used since the days of ancient Hindus. The transabdominal but preperitoneal approach was introduced by **Cheatle** in 1920. The foremost proponent of this approach is **Stoppa** who has developed GPRVS (Giant Prosthesis for Reinforcing the Visceral Sac) technique especially for problematic cases in which repeated repairs with multiple recurrences has occurred. The latest in the armamentarium of the hernia surgery is the laparoscopic repair by which bilateral repair can be performed at the same operation and clinically unsuspected contralateral hernia are also identified and repaired.

ANATOMY OF THE INGUINAL CANAL

“No disease of the human body, belonging to the province of the general surgeon requiring its treatment a greater combination of accurate anatomical knowledge with surgical skill, than hernia in all its varieties” – Sir Astley Cooper. 1804.

The inguinal canal is about 4 cms in length. It is an oblique canal located between the muscles, aponeurosis and fascia of the anterior abdominal wall created by the passage of the spermatic cord in males or round ligament in females. Its internal end is the deep inguinal ring which is a defect in the transversalis fascia, 1cm above the mid inguinal point and immediately lateral to the inferior epigastric artery. Its external end is the superficial inguinal ring, a triangular aperture in the aponeurosis of the external oblique muscle situated just 1cm above and lateral to the pubic tubercle. The base of the ring is formed by the inguinal ligament. Its margins are sewn together at the apex by the intercrural fibers.

Boundaries

Floor

The shelf like Floor is formed by the inguinal ligament and its reflection on to the superior pubic ramus. It is the inturned part of the external

oblique aponeurosis. It extends from the anterior superior iliac spine to pubic tubercle. It continues on to the superior pubic ramus along the pectineal line to form the pectineal ligament.

Anterior Wall

This is formed in its whole length by the aponeurosis of the external oblique muscle and in lateral third by the lowest fibers of the internal oblique arising from the inguinal ligament.

Roof

The inner two layers of the anterior abdominal wall muscles namely inter oblique and transversus abdominis arch over the spermatic cord from there into the iliac crest and lateral part of the inguinal ligament forming the roof of the inguinal canal. Fibers of the internal oblique pass down to envelop the cord and thus constitute the cremaster muscle.

Posterior Wall

The arching fibers of the internal oblique and transverse abdominis joined together to form the conjoined tendon which forms the posterior wall in the medial third. Deep to the transverse abdominis is the endo abdominal fascia. The part of this fascia that lies in contact with the transeversus abdominus is called the transversalis fascia. It passes down to emerge from behind the free lower edge of the transverse abdominis muscle and forms the posterior wall of the inguinal canal in its whole length. It is inserted along the

pectineal line. The deep inguinal ring is a defect in the transversalis fascia through which the spermatic cord enters the inguinal canal. It is bounded medially and inferiorly by a condensation of the transversalis fascia and laterally by the aponeurotic lower edge of the transverse abdominis muscles.

Contents:

The contents of the inguinal canal in males

1. The spermatic cord
2. The vestigial remnants of the processus vaginalis, the fetal prolongation of the peritoneum which accompanies the testis in its descent into the scrotum.
3. Ilio inguinal nerve appears in the medial part of the inguinal canal and enters the superficial inguinal ring.
4. Ilio hypogastric nerve which is strictly not a content of the canal but which is displayed when the canal is open. It lies in front of the internal oblique a little above its lower border.

In females round ligament is found instead of spermatic cord.

The spermatic cord consist of

1. The vas deferens
2. The artery to the vas
3. Testicular artery
4. The pampiniform plexus of veins

5. Lymph vessels
6. Sympathetic nerves
7. Genital branch of Genitofemoral nerve

The cord has three coverings

1. The internal spermatic fascia derived from the fascia transversalis at the deep ring
2. Cremasteric muscle and fascia derived from the internal oblique muscle
3. The external spermatic fascia derived from the external oblique aponeurosis at the superficial ring.

TYPES OF INGUINAL HERNIA

It is based on anatomy and etiology.

Anatomical type

It is divided into direct, indirect and pantaloon based on the inferior epigastric artery which passes upwards close to the medial edge of the deep ring. The part of the transverse fascia medial to the artery bounded by the artery, the rectus sheath and inguinal ligament is known as the Hassalbach's triangle. Indirect inguinal hernia pass through internal ring lateral to the inferior epigastric artery and direct hernia bulge forward medial to the vessel (Hassalbach's triangle) pushing the attenuated transversalis fascia. Pantaloon hernia has both direct and indirect.

Etiology type

Based on the etiology it is divided into congenital and acquired.

Congenital hernia : A preformed sac is present in congenital hernia. The preformed sac is a patent processus vaginalis which is considered to be the cause of inguinal hernia in infants, children and probably in adults. Thus the treatment for inguinal hernia in children is herniotomy. About 20% of adults have a patent processus vaginalis yet most of them do not develop inguinal hernias.

Acquired hernia : The causes may be repeated elevation of intra abdominal pressure and weakening of abdominal musculature and tissues . Increased

intra abdominal pressure is generated when an individual coughs or strains yet the abdominal wall usually maintains the integrity in spite of preformed weak areas notably transversalis fascia and internal inguinal ring. This is explained on the basis of shutter mechanism.

Shutter Mechanism

Contraction of muscles of the abdominal wall raises the intra abdominal pressure. As the external oblique muscle contracts it becomes tense and presses on the weak posterior wall of the inguinal canal and so reinforces it by simultaneously pulling the inguinal ligament upward. At the same time the muscular arch passing over the cord also sharply contracts and as its fibers shorten, the arch is straightened out and comes to lie on or arch close to the raised inguinal ligament in order to protect the weak posterior wall of the canal. As this shutter comes down it passes in front of the internal ring and so counteracts the pressure on the ring from the abdomen the very act of contracting the abdominal muscles in coughing or straining which tends to blow out the internal ring and the transversalis fascia.

Weakening of the muscles and fascia of the abdominal wall occurs with advanced age, lack of physical exercise, obesity, multiple pregnancies, loss of weight and fitness after illness. Here reduction in polymerized collagen and a decreased concentration of hydroxy proline will lead to loss of bonding the collagen fibers. This mechanism is important in recurrent and familial hernia.

Factors like erect posture in human beings and a low lying pubic tubercle may be responsible for inguinal hernia altering the functional anatomy of man such as reduction in the mechanical efficiency of the shutter mechanism. The Cause of inguinal hernia is probably multifactorial. In indirect hernia a preformed sac of processus vaginalis is probably present but bowel is prevented from entering the sac by the muscular action. When a sudden high intra abdominal pressure occurs the shutter mechanism is overcome. In cases with chronic cough, obesity and advanced age the shutter mechanism gradually falls leading to bowel entering the sac in direct hernias.

CLASSIFICATION OF INGUINAL HERNIA

Classification of hernia is important because for any meaningful comparison of different methods of hernia repair, it is important that the same type, the grade and the stage of the hernia is discussed.

The commonly used methods include

1. Gilbert's Classification
2. Nyhus Classification
3. Bendavid Classification
4. Stoppa Classification

Gilbert Classification System

Type 1 Small, indirect

Type 2 Medium, indirect

Type 3 Large, indirect

Type 4 Entire floor, direct

Type 5 Diverticular, direct

Type 6 Combined (pantaloon)

Type 7 Femoral

Nyhus Classification System

- Type 1 Indirect hernia; internal abdominal ring normal; typically in infants, children, small adults
- Type 2 Indirect hernia; internal ring enlarged without impingement on the floor of the inguinal canal; does not extend to the scrotum
- Type 3a Direct hernia; size is not taken into account
- Type 3b Indirect hernia that has enlarged enough to encroach upon the posterior inguinal wall; indirect sliding or scrotal hernias are usually placed in this category because they are commonly associated with extension to the direct space; also includes pantaloons hernias
- Type 3c Femoral hernia
- Type 4 Recurrent hernia; modifiers A–D are sometimes added, which correspond to indirect, direct, femoral, and mixed, respectively

TYPES OF HERNIA REPAIR

The different types of repair of inguinal hernia can be classified into

1. Pure tissue repairs
2. Darn repair
3. Mixed tissue – prosthetic repair
4. Pure prosthetic repair
5. Laproscopic repair

Pure tissue repair

It includes

1. The Bassini's Operation

2. The Shouldice operation

3. The Cooper ligament repair (Iliopubic tract repair)

Darn Repair

The procedure gets its name from the way a long nylon suture is repeatedly passed between the tissues to create a weave that one might consider similar to a mesh. The initial layer consists of a continuous nylon suture to oppose the usual elements of the abdominal wall medially (transversalis fascia and the transversus abdominis, rectus, and internal oblique muscles) to the inguinal ligament. This first suture is continued into the muscle about the cord, weaving in and out to form reinforcement around the cord, and is finally tied to the inguinal ligament on the lateral side of the cord.

Mixed Prosthetic tissue repair

Here sheets of synthetic mesh are laid either deep to the tissue repair as an underlay graft or in front of the repair as an overlay graft. Polypropylene mesh is usually used.

Pure Prosthetic repair

Here no attempt is made to close the defect. A sheet of polypropylene mesh of appropriate size is fashioned to reconstruct the entire posterior wall of inguinal canal without any attempt to close any defect by tissue repair.

The ideal prosthesis should

1. Not be physically modified by the tissue fluid
2. Be chemically inert
3. Not excite an inflammatory or foreign body reaction
4. Be non-carcinogenic
5. Not produce allergy or hyper sensitivity
6. Be capable of resisting mechanical strain
7. Be capable of being fabricated in the form required
8. Be capable of being sterilized

It is unlikely that the ideal prosthesis for hernia repair will ever be developed but today two major mesh concepts are distinguished, the classical concept including so-called heavyweight meshed with small pores and the new concept including light-weight meshes with large pores. Typically, the new

mesh generation is characterized by a reduced weight (depending on the specific weight of the basic polymer), a pore size more than 1 mm, an elasticity of 20-35% (at 16 N/cm) and a physiologic tensile strength of 16 N/cm at minimum.

Small and large porous heavy and lightweight mesh modifications both represent a totally different pathophysiologic view and concept of hernia repair. Heavyweight meshes have been designed to guarantee a maximum mechanical stability, based on the idea of closing the hernial gap with a stiff, nonflexible device inducing maximum scar tissue. In this concept the mesh itself and intense scar tissue formation meshes in the heavyweight group are designed with thick polymer fibers, small pores (<1 mm), a high tensile strength and a large surface area.

In contrast, lightweight meshes are designed to mimic the physiology of the abdominal wall and the inguinal region. Meshes in this group are produced with small polymer fibers, large pores (>1 mm) and a high flexibility. The tensile strength is adapted to that of local tissues and the surface area in contact with the host tissues is low. A welcome and major side effect of the sensitive mechanical adoption of these meshes to the abdominal wall is a significant reduction of scar tissue formation resulting in a long-term flexible repair.

The meshes are divided into nonabsorbable, absorbable and hybrid meshes

NONABSORBABLE MESHES

1. Prolene (Marlex)
2. Polyester (Mersiline)
3. e-PTFE (Gortex)

1. Poly propylene mesh (Marlex)

Introduced by Usher in 1958, Polypropylene mesh has had an enormous impact on surgery over the past four decades and countless patients have benefited from them. It is quite clearly and justifiably the most popular mesh available today for surgical implantation.

Advantages:

- More pliable and readily inserted into any defect size without fragmentation
- More tolerant of bending, flexing and can be used in the groin without discomfort to the patient
- Less affected by infection and granulation tissue will grow through the mesh even in the presence of purulent infection without sloughing or sinus tract formation.

2. Polyester mesh (Dacron, Mersiline mesh)

A polyester polymer from ethylene glycol and terephthalic acid. Extensive clinical experience has developed with plastic mesh repair of abdominal wall

defects. Dacron mesh was the first popular non-metallic mesh to stand the test of time and it remains in active clinical use today although its use has reduced as polypropylene mesh become popular.

3. Expanded polytetrafluoro ethylene (Gortex mesh)

A fully fluorinated polymer with the chemical formula (-CF-CF-) it is an effective bio material for a wide array of clinical problems its unique properties stand it apart from all previous mesh prosthesis that are macroscopically composed of coarse, weave or knit that is freely permeable to air and liquid. In contrast the soft, smooth surface of the e-PTFE patch is non-abrasive, elicits minimal foreign body reaction and is able to support a layer on the peritoneal surface of the patch of neomesothelial cells which results in a low incidence of post operative visceral adhesion formation and reduction in long term bowel complications.

ABSORBABLE MESH

1. Polyglycolic acid (Dexon)
2. Polyglactin 910 (Vicryl)

Presently available absorbable meshes should not be used as the sole prosthesis for the repair of abdominal hernias as they are absorbed in about 90 days. However they have a role in the closure of infected abdominal wall defects.

HYBRID MESHES

1. Vypro Mesh
2. Ultrapro Mesh
3. PVDF (polyvinylidenefluorid) Mesh

1. Vypro Mesh

Vypro mesh is a partly absorbable lightweight multifilament mesh, composed of approximately equal parts of prolene (nonabsorbable polypropylene) and vicryl (absorbable polyglactin). It has large pore construction with filaments further apart compared to prolene mesh over a similar surface area. Here vicryl is fully absorbed through hydrolysis over 56-70 days which leads to 70% reduction in foreign body material.

2. Ultrapro Mesh

Ultrapro mesh is partly absorbable lightweight monofilament mesh composed of approximately equal parts of prolene (nonabsorbable polypropylene) and monocryl (absorbable poliglecaprone). It has thinner filaments compared to prolene mesh and also has large pore construction filaments further apart compared to prolene mesh over a similar surface area. Monocryl is fully absorbed through hydrolysis over 90-120 days which leads reduction in 60% foreign body material.

Textile and mechanical data of Selected meshes

Mesh	Structure	Polymer	Weight (g/m ²)	Suture pull of force		Stamp pressure test	
				Longitudinal (N)	Vertical (N)	Burst Pressure P max (mmHg)	% Stretching at 16 N/cm tension (%)
Prolene	Mono + SP	PP	80-85	116	145	1630	6
Vypro	Multi+ LP	PP	25	30	24	360	31
Vypro II	Multi+ LP	PP	30	40	31	430	28
UltraPro	Mono+ LP	PP	28	42	42	650	25

COMPLICATIONS OF INGUINAL HERNIA REPAIR

I. General Complications

- Pulmonary atelectasis
- Pulmonary embolism
- Pneumonia
- Thrombo embolism
- Urinary retention

II. Local Complications

1. *Ischaemic Orchitis and testicular atrophy*

Signs and symptoms:

- Painful, tender and swollen testicle, spermatic cord
- Occasional mild leukocytosis
- Temperature elevation to 38 or 39 degree centigrade is not uncommon and typically precedes the testicular manifestations

The testicular abnormalities do not become apparent until 2 – 3 days after the operation. The intensity and duration of the signs and symptoms vary greatly and apparently have little bearing in the ultimate outcome.

The Ischemic orchitis may resolve completely or progress to testicular atrophy. Only rarely does the testicular atrophy become gangrenous. Usually

the fever disappears promptly but the testicular pain and tenderness may persist for several weeks. The swelling of the testicle and the spermatic cord lasts much longer and 4 -5 months may pass before the size and shape of the spermatic cord and testicle return to normal. Sometimes the inflammatory process foreshortens the spermatic cord causing the testicle to retract into the scrotum. Such malposition of the testicle is permanent. The return of the testicle to normal size, shape and consistency does not necessarily indicate that the inflammatory process has resolved. In fact in about a third of the patients with Ischemic orchitis the testicle continues to shrink until it is frankly atrophic. In most cases atrophy is apparent within few months of the operation however in some patients as long as 12 months may elapse before the atrophy is fully established. An atrophic testicle is painless and non tender.

Pathology

The cause of testicular atrophy in acute Ischemic orchitis is not known. It may be the result of arterial insufficiency, venous insufficiency or both. Histologically the leydig cells which produce testosterone and the supporting sertoli cells are present with normal appearance. The seminiferous tubules are usually absent. Atrophy of the testis secondary to Ishaemic orchitis is not associated with an increased incidence of testicular malignancy.

Etiology

The aetiology of Ischemic orchitis is poorly understood. Apparently collateral circulation to the testis is very good as the spermatic cord can be divided without Ischemic orchitis necessarily resulting. The causes could be

- Interruption of the testicular blood supply by extensive dissection
- Injury to the cord by reconstruction of the deep and superficial ring too tightly
- Anomalous blood supply to the testis as suggested by Koontz.

The high frequency of Ischemic orchitis in patients undergoing hernia repair for scrotal hernias and recurrent inguinal hernias provide clue to the cause of this complications. The common trait in these patients is extensive dissection, often traumatic because of its extent to free the sac from the cord or to free the previously dissected and scar encased spermatic cord. Such dissection may indeed injure the testicular artery but much more likely to traumatize the innumerable delicate little veins of the pampiniform plexus. The venous insufficiency caused by extensive thrombosis of the veins of the cord is as important as arterial insufficiency in initiating Ischemic orchitis. This contention is supported clinically by the slow onset of the orchitis, the tender, swollen and inflamed spermatic cord. The rarity of testicular gangrene requires orchidectomy.

Prevention and treatment

There is no definite treatment for Ischemic orchitis. Though antibiotics and anti-inflammatory drugs are commonly used, their usefulness is doubtful. Therefore the best method of preventing testicular atrophy would be minimizing the complication of Ischemic orchitis. This can be done by precise and non traumatic dissection of the spermatic cord, meticulous reconstruction of the inguinal canal and whenever possible avoidance of the dissection of the spermatic cord distal to the pubic tubercle in order to preserve collateral circulation. The testis should not be mobilized nor should a spermotocoele or hydrocele be excised concomitantly with an inguinal hernia repair.

One way to minimize trauma to the cord is to leave it in place and untouched the distal portion of the indirect inguinal hernia sac in all but the smallest of the cases. Instead of excising the whole sac one opens it near the internal ring and circumferentially divided. After the proximal sac is freed from the transversalis fascia and its attachment to the cord at the deep ring, the sac may or may not be closed and allowed to retract. The distal sac is left open.

It is impossible to eliminate the complication completely from primary inguinal hernia repair particularly in large, indirect and sliding hernias. Here the sac must be freed entirely to reduce the large intestine that makes part of its wall. Dissection beyond the pubic tubercle is also necessary in patients

with large direct hernias that descent into the scrotum. A too tightly reconstructed inguinal ring produces immediate and obvious engorgement of veins of the cord and necessitates redoing of the reconstruction.

Next there is a possibility that the testicular blood supply may be anomalous. This may be especially important if the external spermatic artery and vein are divided to perform a superior reconstruction of the posterior wall of the inguinal canal. In recurrent hernias reducing the frequency of testicular atrophy may be impossible one way would be to repair hernia preperitoneally. The hernia is approached and repaired posteriorly and an anterior dissection of a previously mobilized cord is there by avoided all together.

Informed consent

In all patients with large scrotal inguinal hernias and recurrent hernias the surgeon should explain and document in detail the nature of this complication.

2. Hemorrhage, Hematomas and Ecchymosis

Hemorrhage and Hematomas are common to all operations and are not Unique to inguinal hernia repair. The precaution to minimize them must be carefully taken. The scrotum often becomes ecchymotic from blood gravitation into the scrotum from inguinal canal. Scrotal ecchymosis is very common with the use of local anaesthesia and when local anesthetic agent

contains epinephrine. Ecchymosis does not interfere with wound healing and is not associated with serious sequelae. The ecchymosis subsides promptly.

3. *Numbness and Paresthesia*

The ilioinguinal and iliohypogastric nerves are the sensory nerves to the groin.

They innervate the pubis, the base of penis, anterolateral aspect of the scrotum and upper medial aspect of thigh. Virtually all patients have numbness and paresthesia in the groin after inguinal hernia repair. Most often these sensations are limited to a small triangular area just inferior and medial to the incision. Sometimes the area of numbness and paresthesia may involve the cutaneous distribution of ilioinguinal nerve. In most instances these sensory changes are temporary and disappear with time. Occasionally some degree of hyperaesthesia, paresthesia and even anesthesia may present for long periods. Usually there is no correlation between patients complaints and nerve injury.

If possible an effort to preserve nerve from stretching or interruption should be made. Often this is impossible and surgeon should not hesitate to divide the branches of ilioinguinal nerve, iliohypogastric nerve because their presence interferes with the performance of a good repair.

4. *Paresis*

The only motor nerve in the groin is the genital branch of the genitofemoral nerve this nerve innervates the cremasteric muscle and also

may have a small sensory component to the lateral scrotum. Division of this nerve along with division of the cremasteric muscle abolishes the suspensory mechanism of the testicle and the cremasteric reflex. The patients may complain of the low position of the testicle in the scrotum and its inability to retract. The onset of the low position can be delayed and in some instances prevented by hitching of the testicle by incorporating by distal stump of the cremasteric muscle and fascia in the reconstruction of external ring.

Paresis of the extensor muscles of the thigh will occur if the femoral nerve is injured. This may occur when the internal ring is made snug by blindly placing a suture lateral to the spermatic cord at the deep inguinal ring. Placing the lateral suture at the deep ring destroys the shutter mechanism of the internal oblique muscle and also might injure the femoral nerve if inserted blindly and deeply. The deep ring should always be reconstructed from the medial side under direct vision by approximating the clearly defined aponeurotic arch and femoral sheath, inguinal ligament.

5. Groin pain

Groin pain is infrequent after inguinal hernia repair the causes include

- Recurrence
- Abdominal muscle strain
- Nerve entrapment
- Neuroma

- Periostitis of the pubic tubercle
- Adductor tendonitis

Most often postoperative groin pain is nonspecific and is due to abdominal muscle

strain from overdoing exercises in a physical fitness program. Such pain stops if the offending exercise is stopped.

Most often injury, strain or inflammation is at the medial portion of the pectineal muscle at or near its origin from the pecten pubis. Pain is often mild and subsides spontaneously. Some cases may need local anaesthetic or steroid injection. Blocking the ilioinguinal or iliohypogastric nerves never abolishes this pain as the pectineal muscle is innervated by the branches of the femoral nerve.

Physical examination with the patient supine and the adductor muscles fully stretched by circumduction of the knee and flexion of the hip and knee reveals sharply localized tenderness of the medial origin of the pectineal muscle just lateral to the pubic tubercle and the taut tendon of adductor longus.

Pain in the groin may be caused by a nerve entrapped by a suture. Scar or neuroma adherent to a muscle produces similar symptoms. Typically the pain is burning or lancinating, aggravated by motion and radiates along the distribution of the involved nerve. The pain can be reproduced by pressure in

the narrowly circumscribed spot to which the patient can point precisely. The ability to abolish the pain completely and repeatedly with local anesthetic is considered pathognomonic of this condition. If the area triggering the pain is very sharply localized, operation might be avoided by permanently blocking the nerve with an injection of absolute alcohol/phenol. More often it is better to explore the wound and divide and ligate the involved nerve, thereby confirming possible neuroma formation within the neurolaminal sheath.

6. Transection of the vas deferens

Transection of the vas deferens is very rare. If accidentally done, it should be repaired immediately after freshening the transected ends and by doing an end to end anastomosis with interrupted sutures of very fine polypropylene facilitated by an intraluminal splint.

7. Visceral injury

The intestine, urinary bladder and ureter may be injured during inguinal hernia repair. The bladder or bladder diverticulum may make up a portion of the wall of a direct inguinal hernia. Bladder injuries can be avoided by inverting the direct inguinal hernia sac rather than excising it. Some large direct hernias may need opening and the bladder may be unintentionally entered. Bladder injury should be repaired in 2 layers with fine chromic catgut and the bladder decompressed with a urethral catheter.

In indirect sliding hernias, the large intestine makes up a portion of the wall of the sac. The bowel may be injured either by entering it directly or devitalizing it through interrupting its blood supply. Incised bowel should immediately be repaired. Devitalized bowel must be dealt with by exteriorization or resection. The ureter is occasionally encountered in both large indirect and direct sliding inguinal hernias. Traumatized ureter must be repaired by carefully anastomosing it with fine interrupted sutures and splinting the anastomosis with a double J.splint.

8. *Recurrence*

The most common complication of inguinal hernia repair is recurrence. Patients with bilateral inguinal hernias have a much greater chance of recurrence than patients with unilateral hernia. Direct hernia recurs more frequently than indirect hernias. Both direct and indirect hernias tend to recur as they occurred primarily i.e. a direct hernia tend to recur as a direct hernia and an indirect hernia recurs as an indirect hernia. Bilateral hernias that are operated on simultaneously recur more frequently than those operated separately.

Defective collagen may be a cause of recurrence for direct inguinal hernias. Tissue necrosis resulting from interrupted sutures tied too tightly or continuous sutures made excessively snug are very important etiologic factors and must be carefully and strictly avoided.

There is a possibility that the recurrent hernia is in fact an overlooked hernia. During primary inguinal hernia repair it is the femoral hernia that is frequently overlooked and during recurrent inguinal hernia repair small direct as well as femoral hernias are most easily missed.

Lastly, faulty evaluation of the integrity of tissues in the groin, especially tissues adjacent to the herniation is an important cause. The tendency for indirect hernias to recur as indirect hernias is probably due to incorrect evaluation of a weak lateral border of the deep ring and is not, as is so frequently suggested to incomplete dissection of the indirect inguinal hernial sac from the deep ring or a loosely reconstructed deep ring.

9. Hydrocele

Very rare after hernia repair. Usually a preexisting hydrocele gets aggravated due to lymphatic obstruction.

10. Sexual dysfunction

All forms of sexual dysfunction have been attributed to inguinal hernia repair, when in fact there is none. Most of these symptoms are functional and occur in patients with preexisting sexual problems. These patients need abundant reassurance and must be treated with understanding and circumspection.

SURGICAL PROCEDURES AND TECHNIQUES

1. Darn repair using 1-0 prolene
2. Lichtenstein's tension free Onlay mesh repair using prolene mesh
3. Both Inlay and Onlay mesh repair by using Prolene hernia system
4. Laparoscopic (TAPP or TEP) groin hernia repair using ultra pro mesh

The above methods are described in detail.

1. DARN REPAIR

The skin incision is made along the line joining the anterior superior Iliac spine and pubic tubercle in its medial two thirds parallel to the inguinal ligament. The subcutaneous tissues in its 2 layers – the fatty layer of camper and the membranous layer of scarpa are incised along the same line. 3 named vessels are encountered – superficial epigastric vein, the superficial external pudental vein and the superficial circumflex iliac vein. They are cut and ligated. The external oblique aponeurosis is opened in the line of its fibers and the iliohypogastric and the ilioinguinal nerves identified and preserved.

Then the cremasteric muscle fibers split open perpendicularly followed by separation of the sac from the cord structures then the cord structures exteriorized. Then cremasteric muscle fibers pre attached with 2-0 chromic catgut by interrupted sutures. This step followed by darning. Here the weakened posterior wall is reinforced with the musculo aponeurotic arch by simple lattice network of non absorbable mono filament (1 -0 prolene) suture

material without any tension. After obtaining complete haemostasis the external oblique aponeurosis closed with continuous sutures using 2-0 chromic catgut. Skin closed with 3-0 ethilon.

2. LICHTENSTEIN'S TENSION FREE ONLAY MESH REPAIR

The skin incision is made along the line joining the anterior superior Iliac spine and pubic tubercle in its medial two thirds parallel to the inguinal ligament. The subcutaneous tissues in its 2 layers – the fatty layer of camper and the membranous layer of scarpa are incised along the same line. 3 named vessels are encountered – superficial epigastric vein, the superficial external pudental vein and the superficial circumflex iliac vein. They are cut and ligated. The external oblique aponeurosis is opened in the line of its fibers and the iliohypogastric and the ilioinguinal nerves identified and preserved.

Then the cremasteric muscle fibers split open perpendicularly followed by separation of the sac from the cord structures then the cord structures exteriorized. After exteriorizing the cord structures the prolene mesh is tailor made according to the defect and placed over the posterior wall of the inguinal canal (transversalis fascia). The mesh is sutured along its lower edge to the pubic tubercle, the lacunar ligament and inguinal ligament using 3-0 prolene as continuous sutures. The superomedial edges sutured to the rector sheath the superior edge is sutured to the conjoint tendon or the muscles of the internal oblique with the few interrupted sutures the lateral edges of the mesh

is split up and the tails are passed around the cord at the internal ring and fixed. Then the external oblique aponeurosis closed with 2-0 chromic catgut continuous sutures skin closed with 3-0 ethilon.

3. INLAY AND ONLY MESH REPAIR -- PROLENE HERNIA SYSTEM

The skin incision is made along the line joining the anterior superior Iliac spine and pubic tubercle in its medial two thirds parallel to the inguinal ligament. The subcutaneous tissues in its 2 layers – the fatty layer of camper and the membranous layer of scarpa are incised along the same line. 3 named vessels are encountered – superficial epigastric vein, the superficial external pudendal vein and the superficial circumflex iliac vein. They are cut and ligated. The external oblique aponeurosis is opened in the line of its fibers and the iliohypogastric and the ilioinguinal nerves identified and preserved.

Then the cremasteric muscle fibers split open perpendicularly followed by separation of the sac from the cord structures then the cord structures exteriorized. Then after developing an anterior pocket under external oblique to optimize the placement of the onlay patch dissect out latterly to ensure sufficient space so that the onlay patch will lie flat. After the posterior wall has been opened, visually confirm that you are in the pre peritoneal space by identifying the yellow pre peritoneal fat and by visualizing the Cooper's ligament.

Then by using the forefinger sweep circumferentially medial, then lateral to actualize the preperitoneal space. Having grasped the onlay patch down to the connector with sponge forceps, align handles parallel to inguinal ligament. Insert device completely into the defect and deploy underlay with forceps or finger.

Suture fixation of the onlay patch is

1. Over the pubic tubercle (essential) and;
2. To the mid-portion of the transverse aponeurotic arch (optional).

Create a slit in the onlay patch to accommodate the spermatic cord.

Suture the mesh to close the slit. Fixation should be $\frac{1}{4}$ inch from the edge of the mesh.

4. LAPROSCOPIC GROIN HERNIA REPAIR

The two methods are Transabdominal preperitoneal approach and Totally extra peritoneal approach

TRANSABDOMINAL PREPERITONEAL HERNIOPLASTY

Position

Patient in supine position with arms by the side. The patient is given 10 degree head down for the bowel loops to fall away from the groin. The position of the surgeon is initially to the left side of the patient during creation of pneumoperitoneum and placement of trocars. Then surgeon moves to the head in and stands on the right side while the camera assistant stands on the

left side. The monitor is placed at the foot end of the patient. The scrub nurse usually stands on the right side of the patient along with the trolley.

Instruments

- 30 degree 10 mm telescope
- Verres needle
- One 10 mm trocar
- Two 5mm trocars
- Holding forceps
- Maryland dissector
- 10mm to 5 mm reducing sleeve
- 5 mm needle holder
- Electro surgical apparatus Monopolar or bipolar
- 15 X12 cm prolene or ultra pro mesh
- 1-0 prolene, 3-0 vicryl

Operative technique

Pneumoperitonium creation

1. Umbilical puncture by veress needle

In the absence of operative scar, periumbilical site is the most preferred site for the veress needle incision. Depending on the shape of the umbilicus either transverse or vertical stab is made with 15 or 11 blade. By

lifting the abdominal wall midway between the pubic symphysis and umbilicus by the non dominant hand the veress needle is inserted perpendicular to the abdomen with the slight degree of tilt so that the tip of the needle faces the pelvis. The needle should be held by the right hand on the shaft, keeping the distal length just adequate for the tip to pierce the full thickness wall of the abdomen.

Aspiration test is used to confirm the position of the needle in the abdominal cavity. 5ml of saline injected through the veress needle and aspirated. If aspiration does not yield the injected solution, then the position of the needle in the peritoneal cavity is confirmed. If the saline is aspirated back into the syringe then it indicates that the needle is with in the layers of the abdominal wall or presence of adhesions. In patients who had undergone surgeries before, incision of veress needle is through right or left hypochondrium (Palmer's point) for creation of pnuemoperitoneum. 3mm scope introduced through the first port followed by insertion of 10mm umbilical port under vision.

2. Open laparoscopy technique

An infra umbilical incision (1- 3 cms) is made and the Subcutaneous tissue is bluntly dissected and retracted. Two clamps are used to lift the line alba and a horizontal or vertical incision of about 1.5 cm is made. The preperitoneal fat is dissected and the peritoneum is incised after lifting it

with a hemostat. Excessive dissection in the preperitoneal space should be discouraged, as the peritoneum falls away from the fascia and the surgeon feels lost in this plane. Two absorbable sutures, preferably Vicryl are placed on either side of the fascial defect. The Hasson's cannula with the blunt obturator is advanced into the peritoneal cavity until the obturator abuts the fascia. The obturator is removed and the sutures are secured firmly to create a seal. The laparoscope is then introduced.

Port placement

Umbilicus – Camera port

Lateral to Rectus sheath – Working ports

Reduction of contents

Hernial defect is identified after introducing the camera. In certain situations the small bowel, omentum or colon is seen hanging from the abdominal wall. The contents of the sac are gently pulled into the abdominal cavity. In some patients the medial ligament is well developed and obstructs the field of vision during surgery. In these situations it is advisable to retract the ligament medially by a percutaneous stitch on the peritoneum.

Peritoneal Incision

A Peritoneal flap is created by a horizontal incision 2 cm above the defect extending from the medial umbilical ligament to the level of anterior superior iliac spine. The incision is curved down like a hockey stick on the

lateral aspect. The dissection is continued downwards beyond the ilio pubic tract by raising a flap of peritoneum. Peritoneal incision should not be extended medial to the medial umbilical ligament as this might result in increased incidence of bleeding from the perivesical plexus of vessels and patent umbilical vessels. Dissection of the entire Hasselbach's triangle and the retro pubic space can be performed easily even without medial extension of the peritoneal incision.

Medial Dissection

Dissection of direct hernias is relatively an easy task. The thinned out transversalis fascia termed as pseudosac, can be readily identified by its glistening appearance. The peritoneum and the preperitoneal fat can be easily separated from this pseudosac by gentle traction with the left hand, while the right hand instrument pushes the pseudosac away from the peritoneum. Sharp dissection in this area in an attempt to resect the pseudosac will produce troublesome bleeding. The dissection should reach the pubic symphysis on the midline. This dissection is useful for identification of a supra symphytic defect in a recurrent hernia and to create a wider space for wrinkle free placement of the mesh. The dissection is restricted to the areolar tissue in order to avoid injury to the bladder, particularly in cases of large direct hernia which might be associated with a sliding component with bladder as its content. In such cases the bladder wall should be carefully retracted by the left hand.

Dissection should always be performed in the avascular, cobweb like areolar tissue. The two handed dissection with active assistance from the left hand is essential for a proper dissection of the preperitoneal space. The right hand instrument is used to dissect the preperitoneal fatty tissue away from the abdominal muscles, while the left hand gasper maintains traction on the peritoneal flap. Very few blood vessels may be encountered during this maneuver. The peritoneal and sub peritoneal blood vessels are coagulated immediately with monopolar cautery, to maintain a clear operative field.

Early identification of certain anatomical structures at this stage is considered vital for safe completion of the surgery. Epigastric vessels, symphysis pubis, pubic ramus and Cooper's ligament are the important structures that require prompt recognition. Care is taken during dissection beneath the ilipubic tract to avoid injury to nerves (Triangle of Pain) and vessels (Triangle of Doom). The abnormal obturator artery and vein with many collaterals in this region should be protected from injury. The obturator foramen and its contents are identified. This forms the inferior limit of the dissection. The bladder should be continuously drained by an indwelling catheter (particularly in patients with pervious surgery, prostatism or irradiation) to prevent accidental injury.

Lateral Dissection

The dissection in the lateral compartment is more challenging as the sac is densely adherent to the cord structures in long standing hernias. The operating table is tilted towards the surgeon, to relieve the arm working at the level of the lateral trocar. (e.g. mild right lateral tilt in right sided hernia). The hernial sac should be dissected close to the peritoneal flap. The relationship of the hernial sac and cord structures is usually constant. The hernial sac is usually lateral to the spermatic cord. At the level of the deep ring the vas deferens curves medially over the iliac vessels after emerging out of the pelvis. The testicular vessels are located on the lateral aspect. The transversalis sling separates the sac and the inferior epigastric vessels. Injury to inferior epigastric vessels can be prevented if the dissection (during separation of the sac from the cord structures) is not continued medially beyond the level of the transversalis sling. Similarly, injury to cord structures can be prevented if the separation of the sac is performed on the upper half of the internal inguinal ring, as the cord structures are usually present on the inferior aspect. Simultaneous traction and application of short bursts of electrocautery helps in severing the dense adhesions between the sac and the cord structures.

Small indirect sacs can be easily dissected out completely into the peritoneal cavity. The sac is separated by a combination of blunt and sharp

dissection along with electro coagulation. In cases of longer sac, the dissection is continued distally into the inguinal canal after creating a window between the sac and cord structures. In these cases, it might need a strong tug with the left grasper to separate the sac from its attachments in the inguinal canal. The dissection should be confined close to the hernial sac. For larger sacs extending deep into the scrotum, particularly congenital type, complete mobilization of the sac is more traumatic and chances of injury to cord structures are increased. In these situations, hernial sac is divided beyond the internal ring within the canal, leaving the distal end of the sac in situ. The proximal sac is separated from the cord structures, high ligation is performed at the neck by endoloop ligation and excess sac is excised. Apart from the structures visualized during medial dissection, laterally placed structures like ilio pubic tract, Triangle of Doom and Triangle of Pain are also exposed during this dissection. It is desirable to retain the preperitoneal fat along with the peritoneum and continue the dissection just underneath the fascia and visible muscle fibres. Any bleeding that obscures the vision must be immediately coagulated to maintain the clarity of the visual field. Monopolar or bipolar cautery may be used minimally as these pose risk of injury to nerves and vas deferens.

Parietalisation

Once the hernial sac is reduced or divided, the peritoneum is separated from the vas and gonadal vessels towards the cranial aspect. This procedure is known as parietalisation. The parietalisation is carried out as far as the middle of the psoas muscle so that the peritoneum is no longer in contact with vas deferens or the vessels in the inguinal region. Extensive parietalisation is important to position the currently recommended larger sized (15X12 cm) unslit mesh. Inadequate mobilization leads to displacement and folding of the mesh and eventually to recurrence. The dissection should be atleast 1-2 cm beyond the edges of the mesh on all sides.

Extent of Dissection

Before placement of the mesh flap should be lifted and the extent of dissection verified. The dissection space should extend beyond the midline on the medial aspect, beyond the anterior superior iliac spine exposing the psoas muscle on the lateral aspect, inferiority up to the symphysis pubis and the level of obturator foramen and superiorly up to the level of working trocars. The peritoneum should be free from the vas deferens and testicular vessels. This wide dissection is needed to ensure problem free placement of 15x12 cm mesh.

Placement of Mesh

The corners of the mesh are trimmed and the lateral ends narrowed to accommodate the space beyond the internal ring. 15x12 cm sized ultra pro mesh adequately covers the entire dissected area reinforce the myopectineal orifice. The folded mesh is reverse loaded into 10-5 mm reducer after trimming the edges. The laparoscope is withdrawn and the mesh is taken into the abdominal cavity by blind insertion through the 10mm trocar. To avoid unnecessary manipulation of the mesh inside the preperitoneal space, it is advisable to place the narrow end of the mesh on the lateral side. The mesh is positioned to cover the entire myopectineal orifice of Fruchaud (direct, indirect and femoral defects).

Fixation of Mesh

The conventional needle of 1-0 prolene is slightly straightened, reverse loaded on to a 10-5 mm reducer and introduced into the abdomen like the introduction of mesh. The mesh is fixed to the Cooper's ligament inferiorly and to the rectus muscle on the superomedial aspect of the mesh, medial to the inferior epigastric vessels. Before fixing to the Cooper's ligament, the dangerous area of Corona mortis should always be carefully inspected. Apart from the areas, fixation of the mesh in the triangle of doom, triangle of pain is totally avoided. Alternatively the mesh can be fixed by the mechanical

fixation devices such as hernia stapler(12mm), tacker (5mm) and anchors (5mm).

Peritoneal Closure

After the placement of the mesh the peritoneum is sutured over the mesh to prevent adhesion of bowel or omentum. More effective peritoneal closure is facilitated by reducing the pneumoperitoneum to 8mm of mercury and flaps closed with 2-0 Vicryl by continuous sutures.

Port Closure

The working trocars are removed under direct vision the bleeding vessels near the ports can be closed by cautery or port closure technique. 5mm trocar sites are closed with subcuticular sutures using 3-0 Vicryl. The camera port repair requires closure of the rectus sheath separately before closing the skin to prevent trocar site herniation. Incases of large scrotal hernias a closed suction drain is kept through a separate stab incision at the root of scrotum. The drain is kept between the mesh and the anterior abdominal wall and removed after 2 – 3 days.

TOTALLY EXTRA PERITONEAL REPAIR (TEP)

Instruments:

10 mm 0 degree scope

Two atraumatic graspers

Endoloop

Suction irrigator

1-0 Prolene

5mm needle holder

Position:

The patient in supine position with 10 degrees head down. The surgeon on the left side introduces subumbilical trocar. Then 5mm working port is created on the contra lateral side of hernia and the preperitoneal space on the side of hernia is dissected to create the space for the placement of next 5mm trocar. Further dissection and placement of the second trocar can be performed from the head end of the patient.

Operative technique

12mm sub umbilical incision extending up to linea alba. The skin and subcutaneous tissues are retracted to the side of hernia or to the dominant side. The subcutaneous tissue is carefully dissected using mayo's clamp to expose the anterior rectus sheath which is incised transversely. The rectus muscle is retracted to enter the space between the muscle and posterior rectus sheath. The curved haemostat is inserted and the space is widened for introduction of trocar. The telescopic dissection with laparoscope is very effective in creation of extra peritoneal space.

Placements of the first trocar

Keeping the rectus muscle retracted anteriorly and to the lateral side, the outer cannula of a 10 mm reusable trocar with its oblique end is carefully guided into the space between muscle and the rectus sheath. This would be approximated with a thick suture material. Wet gauze is plugged between the suture and the wound to prevent leakage of gas. The same suture material is kept long and tied to the insufflation channel to prevent slippage of the trocar out of the incision.

Extra peritoneal dissection

A 10 mm telescope (0 degree) is introduced into the trocar. The scope is then moved downward on the sheath, allowing it to fall between the rectus muscle and the posterior rectus sheath. The telescope is moved forward and backward through the cobweb areolar tissue towards the pubic symphysis. These movements divide the transversalis fascia and the extraperitoneal space is entered. The dissected space is maintained by continuous CO₂ insufflation at 12-14mm Hg. The space created is widened by moving the telescope at various directions. Sweeping movement of the scope should be avoided below the arcuate, as injury to small vessels may cause bleeding in the preperitoneal space. This unnecessary bleeding causes further space creation difficult. The fascia transversalis can be identified by its attachment to the linea Alba on the medial aspect. Once the space is created up to the pubis, the direction of the

scope is turned laterally and the rectus muscle is displaced anteriorly by moving the scope on the posterior rectus sheath, up to the attachment of rectus sheath on the lateral side. During this manoeuvre injury to the branch of the inferior epigastric vessel running over the sheath should be avoided. The dissection beyond midline is performed by dividing the ventral lamina of the transversalis fascia (fused with linea alba in midline). For unilateral hernias dissection up to 2-3 cms on the contra lateral side of the midline is adequate.

Creation of working ports

In case of right inguinal hernia the left hand working port is made just lateral to the midline about 5 cm below the level of the camera port. The extra peritoneal space is widened on the right lateral aspect and the right hand working port is placed on the right pararectus. In case of wide rectus muscle the lateral working port 5 mm is introduced in between the umbilicus and anterior superior iliac spine as laterally as possible (preferably just medial to the lateral rectus sheath fusion). The surgeon moves to the head end of the patient for the rest of the procedure. The order of creation of port slightly differs in case of left sided hernias and bilateral hernias. For left inguinal hernia the right hand working port is created initially just to the right to the midline standing on the left side of the patient. The surgeon then moves to the head end for widening of the extra peritoneal space on the left side, creation of left hand working port and further dissection. In case of bilateral hernias the

left hand working port is created at the level of rectus sheath attachment, after blunt dissection of the extraperitoneal space. Once the left hand port is created further port placement and dissection is carried out from the head end. The surgeon should carefully introduce the working trocars in the extraperitoneal space under vision to prevent laceration of small branches entry into the peritoneal cavity.

Medial dissection, lateral dissection and placement of mesh

Is same as that of TAPP approach described previously.

Fixation on mesh

The mesh is sutured to the Cooper's ligament and superomedial aspect of the mesh to the under surface of the rectus muscle.

Port closure

The CO₂ is released slowly by opening the side channel of 5mm port while the inferior aspect of the mesh held against the psoas muscle. This ensures that the peritoneum covers the mesh without unrolling of the mesh. If CO₂ is trapped within the peritoneum, it is evacuated with the help of a Veress needle or 3mm trocar.

The rectus sheath is approximated and the trocar wounds are closed with subcuticular sutures. In case of minimal bleeding a small vacuum drain is through the 5 mm port which is usually removed in a day or two depending on the drainage.

FOLLOW-UP

The patients were followed up for

1. Analgesic requirements

This is calculated by the number analgesic injection –Diclofenac sodium as demanded by the patient.

2. Seroma

This is diagnosed by post operative ultrasonogram and treated by aspiration.

3. Wound infection

This is divided into superficial and deep mesh related infection treated by appropriate antibiotics by pus culture and sensitivity

4. Cord edema

Patient were assessed for edema of the spermatic cord in the presence of pain ,swelling of the cord between the 1 st POD and for the period of about 6 weeks.

5. Orchitis

Patients were considered to have orchitis in the presence of pain and numbness in the scrotum usually arising after the second post operative day and persisting for variable period beyond one week.

6. Nerve entrapment and its sequelae

Nerve entrapment within the fibrous tissue , mesh and its sequelae like pain ,paraesthesia over the inguinal canal and medial aspect of the thigh.

7. Recurrence

Patients also examined for recurrence during the follow up for 1st month , 3rd month 6th month and then every 6 month.

OBSERVATION AND RESULTS

During the period of may 2007 to November 2009 200 patients with 217 Inguinal Hernias were studied. Out of 217 right side 116(53.45%), left side 67(30.87%), Bilateral 17(7.83%) were noted. Out of 200 patients 130 were more than 40 years and 70 were less than 40 years of age. The mean age is 47.08 years with the range of 19 – 83 years. Out of 200 patients 196(98.0%) were males and 4(2.0%) were females. Out of 217 hernias 150(69.12%) undergone Lichtenstein repair, 41(18.89%) undergone darn repair, 18(8.29%) undergone prolene hernia system repair and 8(3.68%) undergone laparoscopic repair.

Out of 217 hernias, 140(64.51%) were indirect hernias, 49(22.58%) were direct hernias and 28(12.90%) were pantaloon hernias. About 20(9.21%) hernias were associated with hydrocoele on the same side and 3(1.38%) hernias presented with pyocele.

Out of the 217 hernias, 24(11.05%) were presented with obstruction and were operated as emergencies and the remaining 193 hernias in 176 patients were operated electively.

Among the 217 hernias, the following presentations were also noted: 8(3.68%) as recurrences, 5(2.3%) as lipoma of cord, 4(1.84%) as sliding hernia, 3(1.38%) as congenital hernia and 2(0.92%) as undescended testes.

In 193 elective hernia repairs, 6(3.1%) hernias resulted in Orchidectomy, 5(2.61%) resulted in Koontz procedure. In 24 emergency hernia repairs 4(16.6%) resulted in orchidectomy, 2(8.3%) resulted in koontz procedure.

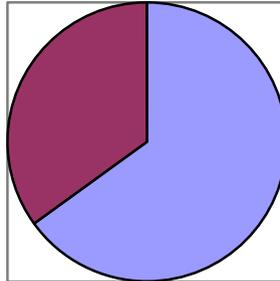
Post operatively out of 41 darn repair, 2(4.87%) had seroma, 2(4.87%) had wound infection, 4(9.75%) had cord edema, 2(4.87%) had orchitis and 1(2.43%) recurrence were noted. There is no case of nerve entrapment and its sequelae noted.

Out of 150 Lichtenstein repair, 5(3.33%) had seroma, 7(4.60%) had wound infection, 6(4.0%) had cord edema, 6(4.0%) had orchitis, 7(4.6%) had nerve entrapment and 1(0.6%) had recurrence were noted.

Out of 18 Prolene Hernia System repairs 1(5.5%) had seroma, 1(5.5%) had cord edema were noted. There was no incidence of wound infection, Orchitis and nerve entrapment were noted|

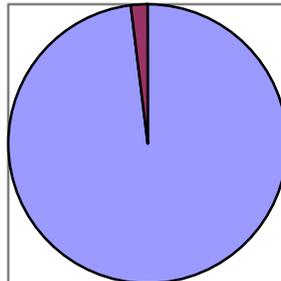
Out of 8 laparoscopy hernia repairs there were no incidence of seroma, wound infection, Orchitis, Cord edema and nerve entrapment were noted. But 1(12.5%) patient had recurrence at 2 months follow up. Another patient developed intestinal obstruction in the 4th Post operative day for which re-laparoscopy was done which revealed failure of closure of peritoneal flap.

AGE GROUP



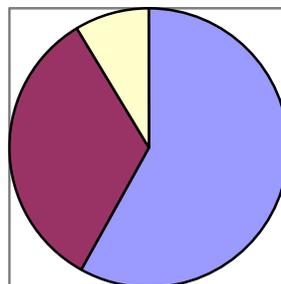
More than 40 years - 130
Less than 40 years - 70

SEX RATIO



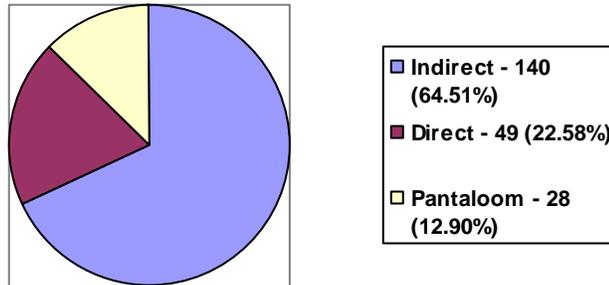
Male - 196
Female - 4

INCIDENCE OF SIDE OF INGUINAL HERNIA

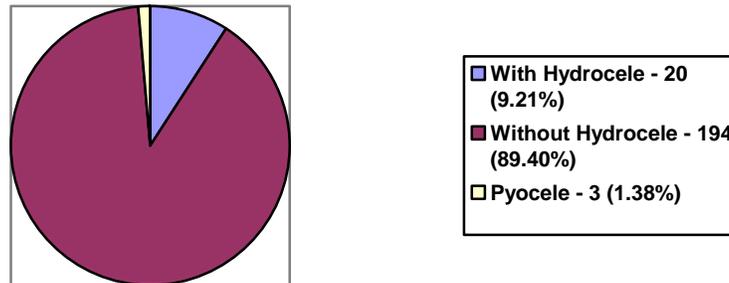


Right - 116 (53.45%)
Left - 67 (30.87%)
Bilateral - 17 (7.83%)

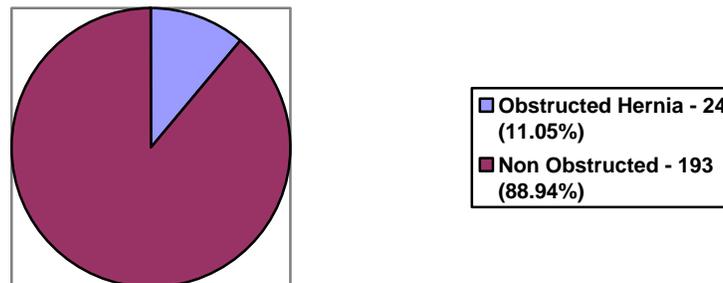
INCIDENCE OF TYPE OF INGUINAL HERNIA



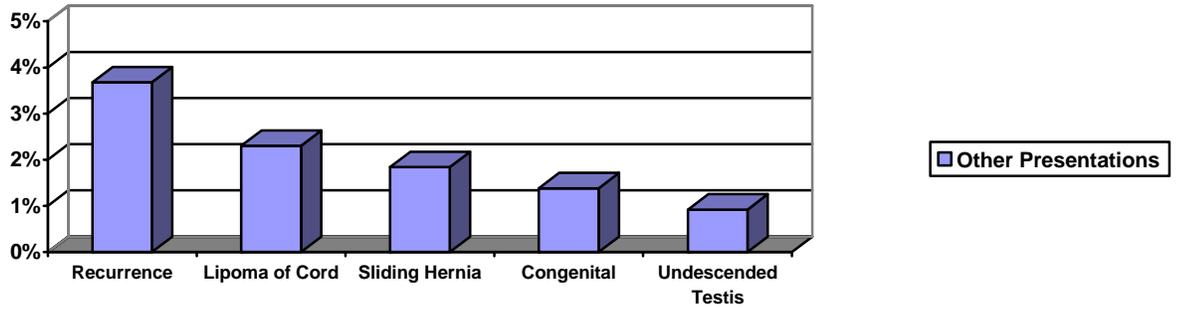
INCIDENCE OF HYDROCELE IN INGUINAL HERNIA



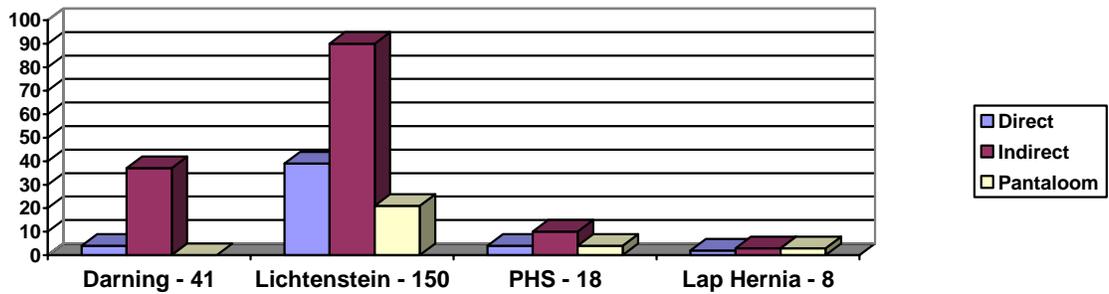
INCIDENCE WITH INGUINAL HERNIA WITH OBSTRUCTION



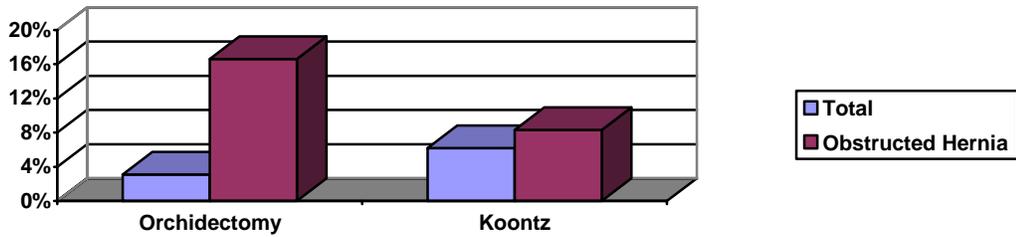
OTHER PRESENTATIONS IN INGUINAL HERNIAS



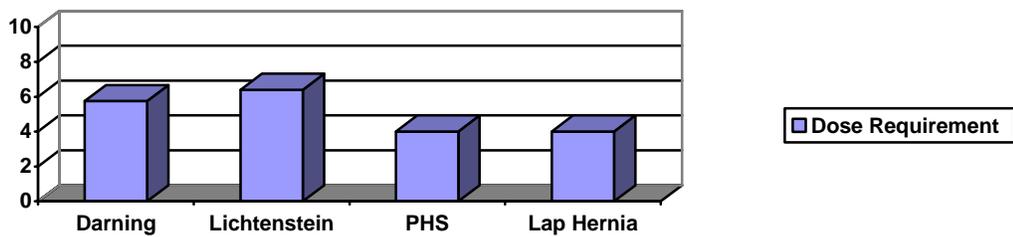
TYPES OF REPAIR



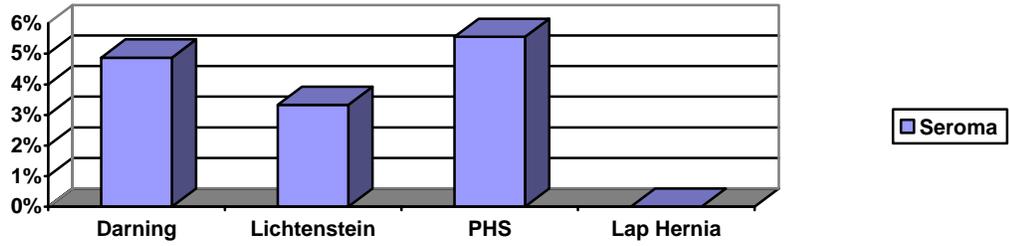
ORCHIDECTOMY / KOONTZ INCIDENCE



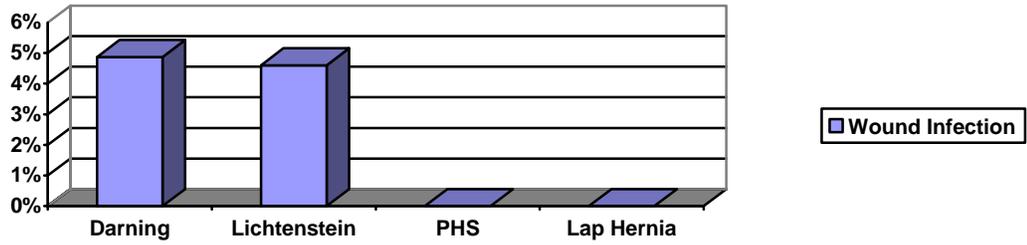
ANALGESIC REQUIREMENT



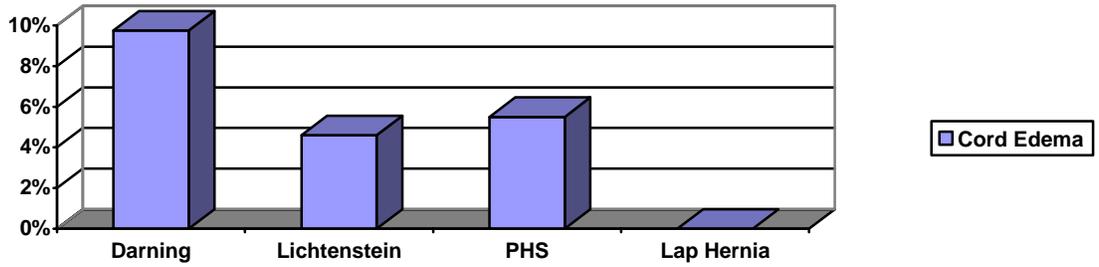
SEROMA



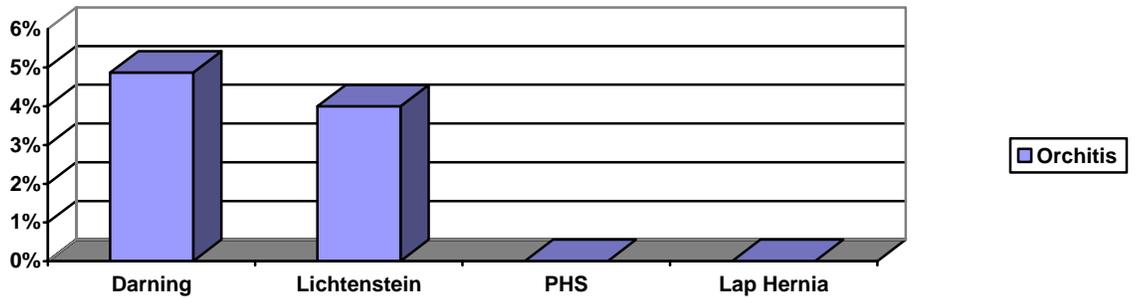
WOUND INFECTION



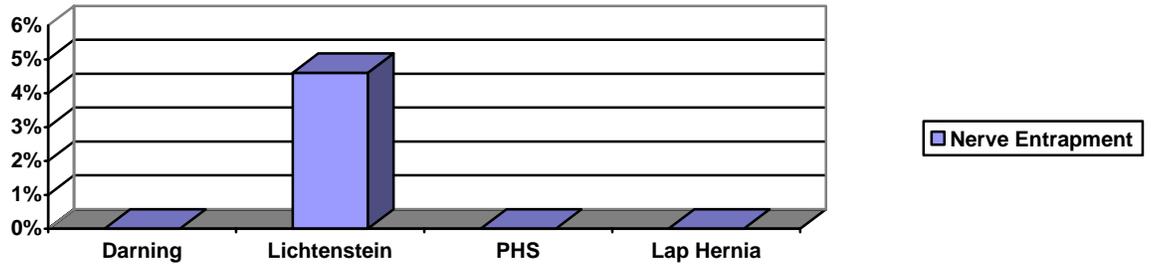
CORD EDEMA



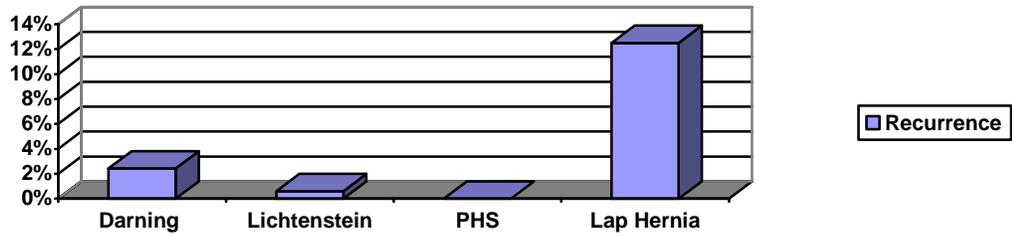
ORCHITIS



NERVE ENTRAPMENT



RECURRENCE



DISCUSSION

In our study, 200 patients with 217 hernias were included, the male to female ratio is 49:1. In accordance with literature and other studies, indirect hernia (64.5%) is the most common type of hernia followed by direct (22.58%) and pantaloon (12.95%) hernias. The mean age of presentation is 47.08 with range of 19-83 years.

Among 200 patients, 176 patients (88.94%) with 193 hernias were treated electively. The remaining 24 (11.05%) patients were operated in the emergency set up for obstruction.

Darn Repair

Study	No.	Seroma	Wound Infection	Cord edema	Orchitis	Nerve Entrap	Recurrence
Burak et al, Turkey 2007	297	6(2.02%)	3(1.01%)	NR	NR	NR	3(1.01%)
Swarup et al, India 2005	120	NR	5 (6.0%)	NR	5(6.0%)	0	0
Rehman et al, Pakistan 2007	50	NR	1(2.00%)	NR	NR	NR	0
GRH, India	41	2(4.87%)	2(4.87%)	4(9.75%)	2(4.87%)	0	1(2.43%)

Nerve Entrap – Nerve Entrapment.

Darn repair was done for 40 patients with 41 hernias (18.89%) out of 24 emergency hernia repairs, 17(70.8%) repairs were done by darn technique due to non availability of mesh and the risk of infection. Post operatively, out of 41 darn repairs, 2(4.87%) had Seroma, 2(4.87%) had wound infection, 2(4.87%) had orchitis which are comparable to those observed by Burak et al, Swarup et al and Rehman et al. Cord edema was not reported in other studies. We had one (2.43%) recurrence which is slightly more than that in the other 3 studies. This may be explained by the fact that our study includes emergency repairs in patients with comorbid conditions, Emergency repair were not included in the 3 reference studies.

Lichtenstein repair was the most commonly performed hernia repair in our study. 137 patients with 150 hernias (69.12%) were operated by Lichtenstein method. It was done mostly for elective cases. Out of 24 emergency repairs, 7(29.1%) early obstructed hernias with no risk of infection were repaid with Lichtenstein method. In our study, the incidence of seroma was 5(3.3%) wound infection was 3(2.0%) which is comparable to other studies like Kark et al, George et al, Bringman et al. Incidence of orchitis 6(4.0%), nerve entrapment 7(4.6%), cord edema 7(4.6%) which were higher compared to other 3 reference studies. There was one (0.6%) recurrence which is comparable to other studies.

Lichtenstein Repair

Study	No.	Seroma	Wound Infection	Cord edema	Orchitis	Nerve Entrap	Recurrence
Kark et al, London 1995	1098	NR	21 (2.10%)	19(1.9%)	19 (1.9%)	10 (1.0%)	1 (0.1%)
George et al, Greece 2001	540	6 (1.10%)	0	NR	5 (1.0%)	5 (1.0%)	1(0.2%)
Bringman et al, Sweden 2003	103	0	4 (3.90%)	NR	2(1.9%)	2(1.9%)	0
Mayagoitia et al, Mexico 2004	125	0	1(0.8%)	2 (1.6%)	NR	4(3.2%)	1(0.8%)
GRH, India	150	5 (3.33%)	3 (2.0%)	7 (4.6%)	6 (4.0%)	7 (4.6%)	1 (0.6%)

Nerve Entrap – Nerve Entrapment

Prolene hernia system repair is a new technique of open hernia repair getting wide acceptance in the recent past. This technique is included in our study only in the last year. And this was performed by surgeons having experience in open hernia repair. 18 hernias (8.29%) were repaired by this technique. In our study, 1(5.5%) had seroma and 1(5.5%) had cord edema which is higher than that of the studies by Mayagoitia et al and Gilber et al. No incidence of orchitis, nerve entrapment, wound infection and recurrence were noted. Study by Gilbert et al (4801 hernia repairs) showed very good outcome with low recurrence rate of 0.06% in the follow up period of 5 years.

Even though our study is very small with a short follow up of 6 months showed very good outcome with this technique but it needs more number of cases and longer period of follow up to conclude.

Prolene Hernia System Repair

Study	No.	Seroma	Wound Infection	Cord edema	Orchitis	Nerve Entrap	Recurrence
Mayagoitia et al, Mexico (2004)	125	1(0.8%)	0	0	NR	1(0.8%)	0
Chauhan et al, India (2007)	44	NR	2(4.5%)	NR	NR	1(2.2%)	0
Gilbert et al, Miami (2004)	4801	77(1.6%)	22(0.45%)	NR	NR	2(0.04%)	3(0.06%)
Faraj et al, Netherlands (2009)	217	NR	NR	NR	NR	7(3.2%)	4(1.8%)
GRH, India	18	1(5.5%)	0	1(5.5%)	0	0	0

Nerve Entrap – Nerve Entrapment

With the advent of minimally invasive surgery, Laparoscopic inguinal hernia repair is done by experts with great enthusiasm. After the introduction of laparoscopy in our department, Laparoscopic hernia repair was started in the last year and was included in this study.

In our study, 6 patients with 8 hernias (3.86%) undergone laparoscopic repair. 3 unilateral and 1 bilateral hernia were repaired by TAPP method.

1 unilateral and 1 bilateral hernia were repaired by TEP method. All patients were operated under general anaesthesia. The operating time was longer than the open hernia repair with less analgesic requirements in the post operative period. There was no incidence of seroma, wound infection, cord edema and orchitis. But 1 patient undergone TAPP procedure developed intestinal obstruction on the 4th POD. For which relaparoscopy was done which showed improper closure of peritoneal flaps. It was repaired and patient went well. One patient developed recurrence at 2 months follow up which was repaired by open method.

Hunterian lecture by David S Evans article noted intestinal obstruction of 0.19% due to failure of peritoneal flaps in laparoscopic repair and recurrence rate of 9% in the early series which was reduced less than 1% in the late series with improvement in surgical technique.

It is well known that laparoscopic hernia repair needs long and steep learning curve so we need more experience in large volume of cases and longer period of follow up to conclude this as a standard technique.

CONCLUSION

Out of 200 patients with 217 inguinal hernias undergone repair in our study, the following were concluded.

In elective cases Lichtenstein method still remains to be the gold standard due to less recurrence rate.

In our study proline hernia system was found to be better than Lichtenstein method in terms of post operative outcome and recurrence rate. But it needs volume of cases and long term follow-up to conclude.

In emergency set-up, when there is unavailability of mesh or risk of infection, darn repair may be done, which gives equally favourable results to that of Lichtenstein method.

In our study laproscopic hernia repair could not be brought into comparison with other studies due to small volume of cases in the learning curve.

REFERENCES

1. Gray's anatomy.- 39th edition.
2. Bailey & Love's short practice of surgery -25th edition
3. Sabiston text book of surgery – 18th edition
4. Schwartz's principles of surgery-8th edition
5. Master of surgery Fisher and Josef E-5th edition
6. Art of Laparoscopy Surgery : C. Palanivelu First Edition.
7. European hernia society guidelines on the treatment of inguinal hernia in adult patient. Simons et al; HERNIA{ 2009 } 13;343-403.
8. Open tension free repair of inguinal hernias; Lichtenstein technique.
Georg H Sakorafas et al; BMC surgery 2001,1;3
9. Tension free inguinal hernia repair:TEP Vs mesh-plug Vs Lichtenstein
Swen Bringman et al; ANNALS OF SURGERY ,Vol, 237.No 1,142-147
10. Tension free mesh hernia repair: review of 1098 cases using local anaesthesia in a day unit. Ann R Coll surg Engl 1995;77:299-30.
11. Moloney Darn repair Vs Lichtenstein mesh hernioplasty for open inguinal hernia repair. Burak Kaynak et al: Surg Today {2007}37:958-960

12. Tension free inguinal hernia repair comparing Darn with mesh: A prospective Randomized controlled clinical trial. Swarup et al: Indian J surg 2007;69;52-6
13. Darning Vs Bassini repair for inguinal hernia. Profesional Med J Mar 2007,14{1}
14. Combined anterior and posterior inguinal hernia repair: Intermediate recurrence rates with three groups of surgeons. Gilbert et al : Hernia (2004) 8: 203-207
15. Inguinal hernioplasty with the Prolene Hernia System. Mayagoitia : Hernia (2004) 8: 64-66
16. Study of Efficacy of Bilayer Mesh Device versus Conventional Polypropylene Hernia System in Inguinal Hernia Repair: Early Results. Chaunhan et al: World J Surg (2007) 31:1356-1359.
17. Five-year results of inguinal hernia treatment with the Prolene Hernia System in a regional training hospital: Faraj et al: Hernia (2007).
18. Laparoscopic transabdominal pre-peritoneal (TAPP) repair of groin hernia: one surgeon's experience of a developing technique: David S Evans: Ann R Coll Surg Engl 2002; 84: 393-398.

19. Randomised controlled trial of laparoscopic versus open mesh repair for inguinal hernia: outcome and cost: Wellwood et al: BMJ volume 317 11 July 1998.
20. Five-Year Follow-Up of Patients Undergoing Laparoscopic or Open Groin Hernia Repair: A Randomized Controlled Trial: Wright et al: Annals of Surgery Vol. 235, No. 3, 333-337
21. Laparoscopic Mesh Versus Open Preperitoneal Mesh Versus Conventional Technique for Inguinal Hernia Repair. A Randomized Multicenter Trial (SCUR Hernia Repair Study): Johansson et al: Annals of surgery Vol. 230, No. 2, 225-231.
22. The lightweight and large porous mesh concept for hernia repair: Klosterhalfen et al: Expert Rev. Med. Devices 2(1).

CASE PROFORMA

NAME: AGE/SEX IP. NO: ADDRESS

PATIENT DATA

1. Occupation
2. Risk factors (Weight, Family history, Long term heavy weight lifting, Appendectomy, Smoking, COPD, Prostatism, Constipation)
3. How long the hernia has been present?

OPERATION DATA

1. Operation date
2. Emergency/Elective
3. Antibiotics
4. Anaesthesia (Local, Spinal, General)
5. Recurrence (Recurrence number, year last operated, technique last used)
6. Bilateral
7. Contralateral Inguinal hernia
8. Side
9. Non reducible (Obstruction, Strangulation)
10. Testis preoperative
11. Other concurrent intervention (Orchidectomy, Koontz)
12. Length of operation

HERNIA DATA

1. Type (Direct, Indirect, Pantaloom, Recurrence and Others)
2. Sliding hernia
3. Scrotal hernia

OPERATIVE TECHNIQUE

1. Conventional (Darn repair)
2. Anterior open technique (Lichtenstein, Prolene hernia system)
3. Laparoscopic repair (TAPP or TEP)

POST OPERATIVE COMPLICATIONS

1. Post Operative pain and analgesic requirement
2. Seroma
3. Wound infection
4. Cord edema
5. Orchitis
6. Nerve Entrapment and its sequelae
7. Vascular intestinal, Bladder damage, Urinary retention
8. Cardiac, Pulmonary complication
9. Recurrence
10. Others

FOLLOW UP

Months of follow up for recurrence, pain.