International Surgery Journal
Ray MS et al. Int Surg J. 2017 Jan;4(1):348-355
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: http://dx.doi.org/10.18203/2349-2902.isj20164468

Original Research Article

Stoppa's modified, open preperitoneal prolene mesh hernioplasty: a critical analysis of operative outcome in 70 cases

M. S. Ray, B. S. Deepak*

Department of Surgery, Military Hospital, Jalandhar Cantt, Jalandhar, Punjab, India

Received: 15 September 2016
Revised: 22 October 2016
Accepted: 24 October 2016

***Correspondence:**
Dr. B. S. Deepak,
E-mail: deepaksatyapal@gmail.com

ABSTRACT

Background: Since the dawn of the surgical history, hernias of the abdominal wall have been the most common condition requiring surgery. Hernia poses a major surgical health concern in any society. Despite the frequency of surgical repair, perfect results continue to elude surgeons, and the rate of recurrence is humbling. Hernia has been known since evolution of man and the history of hernia is the history of surgery. Stoppa et al first described a technique aimed at eliminating hernias by reinforcing the peritoneal space with a giant prosthesis called the giant prosthetic reinforcement of visceral sac (GPRVS). This research article presents our experience in managing a varied range of abdominal hernia by not so often practiced Stoppa's GPRVS with significant modifications and very good results. The aim was to evaluate the operative outcome by Stoppa's modified open preperitoneal prolene mesh hernioplasty in primary/recurrent/multirecurrent abdominal hernias and to determine the complications.
Methods: This study was carried out in our hospital between May 2008 and June 2010. Total of 70 patients were included in the study which were managed by modified Stoppa's modified open preperitoneal prolene mesh hernioplasty.
Results: This procedure has certain inherent advantages like it avoids entering a defiled surgical plane through distorted anatomy, in cases of recurrent hernia and permits inspection of all potential hernial sites. It is truly tensionless and sutureless repair.
Conclusions: This novel technique has given excellent results. We would like to recommend Stoppa's repair based on our experience for recurrent and multirecurrent abdominal hernias, large Incisional and bilateral inguinal hernia.

Keywords: Abdominal hernias, Giant prosthetic reinforcement of visceral sac, Hernia, Preperitonial

INTRODUCTION

Hernia (Latin, rupture; Greek, bud) defined as protrusion of a viscus through an opening in the wall of the cavity in which it is contained. [1] The common feature possessed by all hernias is the existence of a zone of weakness by way of which structures can pass through the wall of the cavity which contains them. Oesophageal, aortic, caval hiatuses provide high-roads for diaphragmatic herniation upwards, as do inguinal, femoral, obturator and sciatic downwards from abdominal cavity. The umbilicus provides a gap in the abdominal wall. Approximately in 5-15% who have had an abdominal incision, which develops an incisional hernia.[2] Out of all the potential hernial sites inguinal area is unequalled in its structural weakness. In addition, due to the upright position acquired by man in course of evolution, the inguinal region is subjected to a large part of the weight of mobile intestines, which contributes towards the high incidence of herniation in human beings. Hernia has been known since evolution of man and the history of hernia is the history of surgery as stated by Jose Felix.[3] After the

advance made by Marcy and Bassini (1889) little was done in the decade following the publication of the treatment of hernia. Ever since, individual surgeons have contributed countless modifications, to be decried at one time or the other. For the first time a specialized center for treatment of hernia, Shouldice clinic was opened in Ontario in 1945. In the next 30 years over 80,000 cases were operated and subsequently followed up for hernia recurrence. The reported recurrence rate was an amazing 0.8%.

Approximately 25% of males and 2% of females have inguinal hernias in their lifetimes.[5,6] Approximately 75% of all hernias occur in the groin, two thirds of these hernias are indirect and one third are direct. Indirect inguinal hernias are the most common hernias in both men and women; a right-sided predominance exists.[7] Incisional and ventral hernias account for 10% of all hernias.[8] Data from India and other developing countries is limited; therefore, an accurate incidence value is unavailable. Current epidemiologic assessments postulate that gender and anatomic distribution are similar. Despite the seemingly straightforward steps of the various inguinal hernia repair procedures, it is apparent that strict adherence to anatomic planes of dissection as well as precise knowledge of potential pitfalls are an absolute-must. In this article our aim and objective was to evaluate the operative outcome by modified Stoppa's open preperitoneal prolene mesh hernioplasty in primary/recurrent/multirecurrent abdominal hernias and to determine the complications.

METHODS

This study was conducted at Gastro Intestinal Surgery (GIS) Department of Surgical Division between May 2008 and June 2010. The primary inclusion criterions in 70 patients were the presence of an anterior abdominal wall hernia which were managed by Stoppa's Modified open preperitoneal prolene mesh hernioplasty.

Figure 1: Giant recurrent incisional hernia abdomen (pre-op).

The patients who were excluded were with those requiring emergency operation due to complication of hernia, those in sepsis, those unfit for general anesthesia and those having skin infection and pediatric cases. All the 70 patients underwent a pre-op, clinico-laboratical evaluation and pre-anesthesia clearance (PAC). PAC cleared patients were engaged in "pre-op talk" where they were briefed in detail about the procedure, design protocol, risk-benefit ratio and probable complications. A written informed consent was then obtained and filed.

Figure 2: Giant bilateral inguinal hernia (pre-op).

Operative steps

Pre-incision protocol

Patient, identified, taken up supine, "lined" and pre-incision broad spectrum I/V antibiotics fired (ciprofloxacin, amikacin, and metronidazole).

Dissection

Appropriate midline, scar excising (where indicated) incision marked with skin pen, made and developed. In the sub umbilical region the preperitoneal cleavage (dissection/separation) started from the lower portion on the median line incision and progressed into Retropubic Space of Retzius. This is done rapidly and easily by surgeon's index finger. The dissection advances downward in front of the bladder, up to the prostatic compartment, and then behind the iliopubic ramus in the Space of Bogros, fans out laterally and up the flanks lateral to rectus abdominis.[9] The pedicle of inguinal hernia is isolated. A strong adherent sac of a multirecurrent hernia needs to be dissected and freed, in such cases the sac is resected and thereafter the peritoneum is sutured. Next, the preperitoneal cleavage is continued easily over the external iliac vessels and to the ureter. In male patients the vas deferens, testicular and gonadal vessels are separated out laterally away from the visceral sac. Next, the surgeon changes sides and similar dissection is carried out on the contra lateral side. It is not necessary to pursue dissection above the Arcuate line of Douglas in cases of infraumbilical hernias. In cases of supraumbiical hernias, we did retromuscular dissection (behind the rectus abdominus muscle) above the Arcuate line of Douglas, incising under vision, the lateral fusion of anterior and posterior rectus sheath and linea alba in

the midline. This helps increasing a wide pre-peritoneal space from flank to flank and xiphoid to retropubic space.

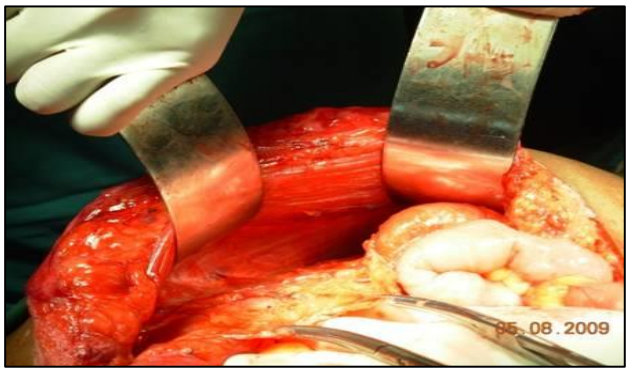

Figure 3: Per peritonial space being disected (Space of Bogros).

Dealing with peritoneal tear

Small peritoneal tear were repaired with 3'0 vicryl sutures and for large tears vicryl mesh or omentum was used as a 'bridge' and an interface between the bowel and the prolene mesh. In some cases dual mesh was used.

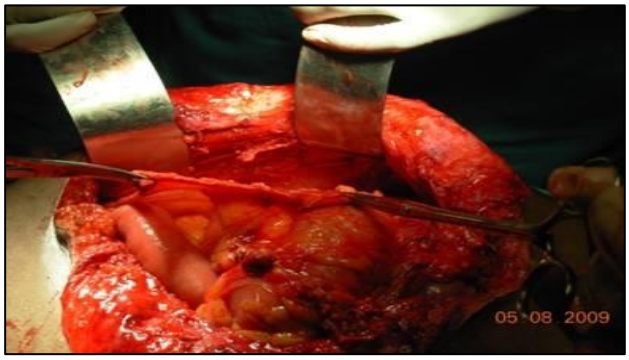

Figure 4: Per peritonial space being disected (laterally).

Additional procedure

For all non appendectomised patients, appendectomy was done. For patients who had gall stones, in whom supraumbilical retro muscular dissection was being done for hernia repair, we also carried out cholecystectomy with separate sets of instruments, which were discarded along with the gloves of the surgical team, before prolene mesh is handled for mesh hernioplasty.

Specimen (appendix and/ or gall bladder) were sent for histo-pathological examination (HPE) mandatorily.

Dealing with sac

Sac which could be dissected out of the inguinal canal were excised and defect closed with vicryl suture or inverted on itself and base sutured with vicryl.

Dealing with large and wide deep inguinal ring

We used "mesh cones" and mesh plug rolls, which were snuggly deployed into the wide internal ring and held in place with a couple of 3/0 vicryl sutures. This effectively neutralized a potential space for re-herniation.

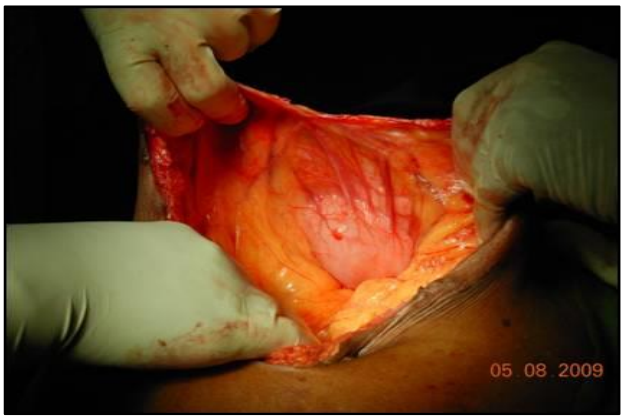

Figure 5: Giant hernial sac.

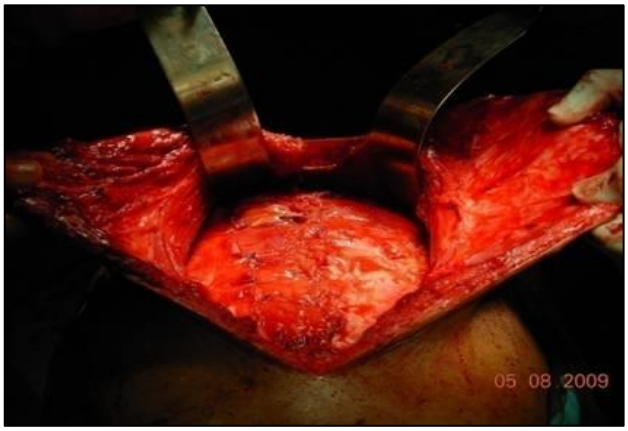

Figure 6: Peritonial tear sutured and "patched" up with vicryl or omentum.

Figure 7: Large 30 x 30 cm prolene mesh being placed in pre-peritoneal space.

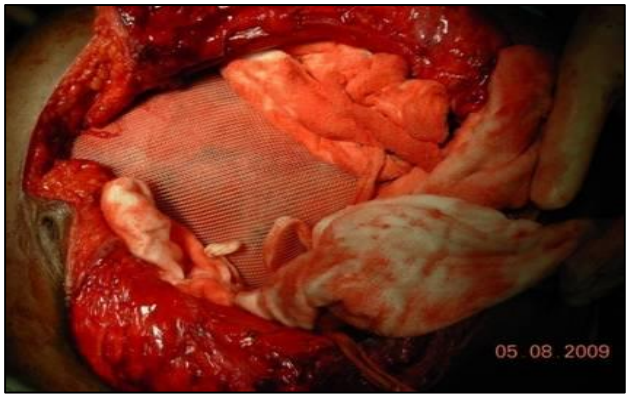

Figure 8: Pre-peritoneal space packed with Gentamicin-Saline soaked swab as temporary mesh anchoring wedges.

Placement of prosthesis

We used large sized monofilament polypropylene (prolene) mesh prosthesis (sizes varying from 30 x 30 cm, 30 x 15 cm, 15 x 15 cm). In many cases more than one mesh was used. The prosthesis is measured directly on the patient to facilitate implantation of largest mesh size possible. The correct transverse diameter of the prosthesis is equal to the distance between the two anterior superior iliac spines (ASIS), minus 02 cm. The correct vertical dimension is the distance between umbilicus and pubis or the vertical length of the incision, whichever is more. The prosthesis is then cut into "large blunt arrow head with of pantaloon legs" shape. Before placement the prosthesis is soaked in gentamicin saline. The giant prosthesis is then simply spread out by grasping its corners with long Kelly forceps or pinching the corners between index and middle finger and gently developing the mesh in the farthest recesses of the per-peritoneal space. The mesh is held in place with couple of gentamicin saline soaked abdominal sponge bolsters. Similarly the mesh is deployed in contra lateral side and held down with sponge as wedges.

The drains

Thereafter two pre-mesh suction drains are placed (18/16Fr Romovac). Next linea alba is reconstructed with PDS 01 loop, any divarication of recti is rectified along with the subcutaneous wound closed over two subcutaneous suction drains (16 Fr Romovac) coming out of the two ends of skin incisions complementing each other. Skin is closed with Nylon/silk sutures or skin staplers.

On table abdominal binder

On table abdominal binder is applied mandatorily to "kill" the preperitoneal "dead space" which could be potential space for collection of blood and lymph despite the suction drain. Pneumatic compression devices were used intra-op and post-op to avoid DVT.

Post-op care

Broad spectrum antibiotics, Proton pump Inhibitors, NSAID's and lung and limb physiotherapy started. Early ambulation and oral feeds encouraged. Urinary catheter removed by 03rd post-op day and drains by 5th post-op day. Sutures were removed by 14th post-op day. Advised to use abdominal binder during day time for about 03 months. Patient reviewed with HPE report (appendix and or gall bladder as the case maybe) on the 14th post-op day and followed up 03 monthly for the 1st year to check for recurrence of hernia.

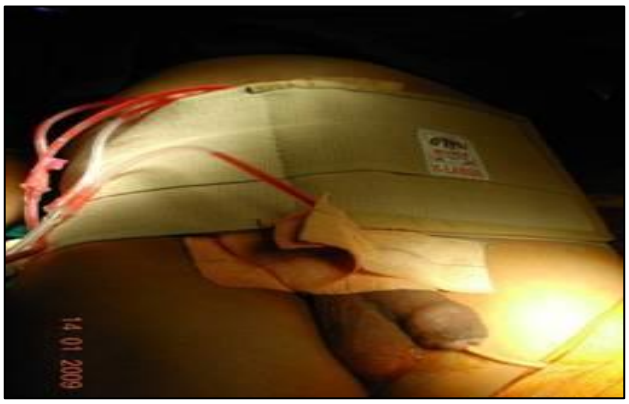

Figure 9: On table mandatory abdominal binder.

Figure 10: Sutures removed on 14th post op day.

RESULTS

A total of 70 patients were enrolled for the study. The age of the patients varied from 26 to 84 years with mean of 53.5 years. Sex distribution, 44 patients were male and 26 were females. 15 patients were tobacco smokers and all were males.

The average operating time is 118 min for incisional hernia and 90 min for bilateral inguinal hernia and the incidences of complication were very minimal. There were 15 adult patients which had wound infection which were managed accordingly.

DISCUSSION

History stands out as witness, that through the ages, abdominal hernias have been the "bug bane" to mankind! Hernias and failed hernias continue to torment the patients, and humiliate their surgeons mercilessly.

Advantages of preperitoneal prolene mesh hernioplasty

Stoppa's GPRVS provides certain inherent advantages to the surgeon.[9,10,11]

- This procedure avoids reopening through distorted anatomy in cases of recurrent/multirecurrent hernias
- Exploits pascal's principle to hold the mesh in place suturelessly
- Permits inspection of all potential abdominal hernia sites
- Tensionless and sutureless repair
- Reduces the risk of nerve injury, neuralgia, orchitis, testicular atrophy and chronic pain. These as stated by Stoppa, are potential medico legal complications which are frequent in other inguinal herniorrhaphies
- This space is a virgin space typically intact during repair of recurrent hernias which greatly facilitates the procedure.

Our modifications

In our study we have introduced certain modifications to the original procedure described by Dr. Rene Stoppa (GPRVS in 1969), hence we call it stoppa's modified open preperitoneal prolene mesh hernioplasty.

Elective additional procedures with consent

Appendicectomy

All non-appendectomised patients were subjected to appendicectomy (prophylactic appendectomy).

Cholecystectomy

In diagnosed cases of gall stone disease (GSD), if dissection was done above the Arcuate line of Douglas i.e. retro muscularly, we removed the gall bladder by standard open cholecystectomy technique.

The rationale behind above additional procedures (elective appendectomy and cholecystectomy) are that, after the Stoppa's mesh hernioplasty, if the patient has acute appendicitis or has the need to undergo cholecystectomy repair then a previously repaired abdomen would be a potential site for chronic mesh infection and later on can be a site of Incisional hernia. So the above mentioned additional procedures are a sure shot method of removing the 'very recipe' that can jeopardize a perfectly executed Stoppa's prolene mesh hernioplasty. Stoppa's mesh hernioplasty is an implant surgery, where non-absorbable prolene mesh, tissue prosthesis (foreign body) is left in situ for life. In all implant surgery (such as cardiac valve surgery and orthopedic surgery) it is universally considered a 'crime' to implant prosthesis in presence of potentially infective tissue, like in the case of this study gall bladder with stones and appendix with past history of infection.

One of the issues of our study was to see the feasibility in terms of complications, of doing appendectomy and /or Cholecystectomy in the same sitting as Stoppa's GPRVS. We had no complications for doing so.

Retromuscular space dissection

For hernias above the Arcuate line of Douglas, in our study, for large abdominal hernias, we have done retro muscular dissection to achieve a 'Single large unit of preperitoneal space' for proper placement of large 30 x 30 cm prolene mesh. (This has not been described by Rene Stoppa's initially).

Ligation of inferior epigastric vessels

We experienced troublesome hemorrhage in few cases from inferior epigastric vessels requiring blood transfusion; hence we have routinely ligated these vessel.

Plugging of inguinal canal defect

This was done with prolene mesh cones /plug rolls. They have proved effective in obliterating a large and wide deep ring without inviting serious troubles such as seen arising out of inadvertent misadventure in the 'Triangle of Doom', 'Triangle of Pain' and 'Circle of Death', during suture/patch closure of the wide internal ring. Patients have tolerated these prolene cones and plugs very well.

Use of vicryl mesh

We had few cases of peritoneal tear more so in dissection above the arcuate line of douglas. The prolene mesh is known to cause perforation and fistulation of bowel on prolonged contact; hence for large peritoneal tears we used vicryl mesh as an interface between bowel and prolene mesh as a protective measure.

Drains (to drain or not to drain)

The GPRVS requires extensive dissection of the pre-peritoneal space to create a visceral sac of peritoneum that is wrapped around with large prolene mesh tissue prosthesis. The body responds to this with products of large volume of lymph and oozing as seroma and haematoma. To avoid these we used pre mesh drains (16/18 Fr Romovac) without fail in all our cases. Subcutaneous drains were deployed in all cases in our study to obliterate relatively avascular fat planes "dead space". Stoppa had initially used premesh drains in

selected cases, however subcutaneous drains were not used by him.[9] He did have post-op seroma and haematoma complication, which were managed by repeated and selective aspiration. Despite drains in our study we had seroma-07, superficial wound infection-04 and wound failure-02.

On table abdominal binder

This has been a mandatory final on-table procedure, this presumably helped pressure obliteration of large preperitoneal space, so dissected to place the mesh. Without this binder the preperitoneal space could have been cause for troublesome seroma, haematoma and abscess.

Our choice of mesh

Unfortunately the ideal mesh prosthesis is yet to be found. Existing data suggest that absorbable mesh do not remain in the wound long enough for adequate collagen to be deposited, this in the backdrop of evidences that in adult hernias a metabolic defect in collagen synthesis is involved. Multi filament and braided mesh can harbor bacteria in spaces too small for normal body mechanisms to eliminate them. Mesh (especially PTFE, teflon/teflon coated) that fibroblasts cannot adhere to, and cannot infiltrate does not lead to desired strengthening of the abdominal wall.[12] Stoppa used dacron (polyester).[13] Wantz used Mersilene (loosely braided fine fibers of pure uncoated Dacron). His points were that it has a texture that grips the tissue and prevents slippage, fibroblastic infiltration is fast.

We used polypropylene mesh of sizes 30x30cm, 30x15cm, and 15x15cm for pre-peritoneal repair and Vicryl mesh 15x15cm for peritoneal tear repair.

Complications

Since the wide spread acceptance of tension free mesh hernioplasty, there have been reports of several complications, seroma, haematoma, wound infections, wound dehiscence and mesh infection.[9-11]

Late complications like chronic discharging sinuses, deep seated infections, prosthetic infection and enteric fistula. There are case reports of mesh migration causing perforation of colon and bladder.[15] We had 07 cases of seroma in subcutaneous plane which were managed by 'small nick' drainage and dressing. There were 04 cases of superficial wound infection, the wound culture report showed bacterial growth in 03 cases, the organism isolated were- *Pseudomonas, Staphylococcus, E. Coli* (01 each) and in 01 case the culture report was sterile. Patients were managed with dressings using hydrogen peroxide and betadine/ Edinburgh University Solution (EUSOL). All 04 such cases were successfully managed by above measures with no long term morbidity.

In the study there were two cases in which mesh was exposed with wound dehiscence. Both patients were elderly females with comorbidities of diabetes and hypertension. As the patients were not in sepsis a trial was given to save the mesh from removal. Comorbidities were managed aggressively to keep the blood sugar <150 mg%. Antibiotics were changed depending on culture report. Dressing was done along with desloughing. Slowly the wound granulated from the base. After ruling out local infection clinically and by culture report, the wounds were secondarily sutured in the operation theatre. Definitive treatment of deep seated prosthetic infection is controversial, whereas most authors recommend removal of mesh others prefer a conservative approach in absence of enteric fistula.[15] In our study patients were not in sepsis and there was no enteric fistula. The patients were managed without removal of mesh.

Post-op hospital stay

Various studies state hospital stay after Stoppa's GPRVS of 2.5 -3.5 days.[16] In this study, the mean hospital stay was 06 days. There are multiple factors for this. We operated on elderly population with most having comorbidities. Most of the patients were not residents of the city in which study was done and hence we held on to them till we were sure that there were no co morbidity related complications. Moreover patients had social and logistic problems like staying out in hotels and boarding homes. The study was carried out in a hospital in which the clientele did not have to pay for the services rendered and bed availability constraints were not compelling.

Recurrences

Incisional hernia develops in 2-11% of patients who undergo laparotomy.[17] After repair these hernias recur in 30-60% of patients in whom a prosthetic mesh has not been used. The development of tension free Incisional hernia repair with prosthesis has decreased recurrence rates to 8-10%. A recent review indicates that first time recurrent hernia repair fail in 1-30% cases, that second time recurrent hernia repairs do so in 3-35% cases and third time or more repairs fail in 50% cases. Authors have stated that recurrence rate has been the major, if not the sole criterion on which the efficacy of any hernia repair is judged. Recurrence rates reported by other authors for GPRVS: Rene Stoppa (2-3.3%) in his initial article and 0.5-1.1% in later articles.[17-19] In a series of 57 patients studied by Stoppa's GPRVS, there were 01 recurrence, seroma-12%, wound infection-3.5% (requiring prosthesis removal). Nyhus - 1.7% for recurrent hernias and 0.56% for primary repairs.[11] The range of recurrence reported from various studies 0 - 13%.[10] In our study we had 02 (2.8%) recurrences. Both were cases of primary inguinal hernia. The recurrences occurred between 3-6 months post op. There were no recurrences in repair of recurrent/multirecurrent hernias which constituted of 18 (25%) cases.

Studies state that in GPRVS the recurrences are mostly in first 06 months and more likely due to technical failures like small size of mesh, splitting of mesh, wrong placement, inadequate dissection, inadequate mesh over-lap fixation, prosthesis folding or twisting or missed hernias. In GPRVS, the replacement of the endoabdominal fascia seals the inguinal, femoral, obturator canals and other potential hernia sites, hence late recurrences are not common. In theory recurrences after GPVRS are inconceivable, but they do occur. Although patient factors are at play, most authors believe that recurrences are due to technical faults, most common being inadequate size of mesh.[20] It has been statistically deduced that mesh less than 04 cm^2 size cannot be held by "pascal's law", but are to be anchored to the underlying tissue with interrupted sutures or else they will suffer "mesh migration" leading to recurrence of hernia.

Learning curve

There are article which states that Stoppa repair is technically difficult and not for everyone.[21] Our experience is that this technique is simple with a short learning curve, probably 5-7 surgeries. Comparing this to the laparoscopy preperitoneal repair where the learning curve is steep with estimated 40-50 cases as reported in articles.[22-24] We believe that GPRVS can be practiced safely and effectively even by not so experienced surgeons.

Statistical analysis

The statistical analysis of data collected was done using Pearson's chi square test and Fisher's exact test. This was done to compare the complications with other variables. The comparison of significance were, patient's with BMI >30 had higher rates of wound complication ($p < 0.06$). Female patients had higher rate of wound complications ($p < 0.012$). We found that patients with diabetes had higher rate of complication ($p < 0.002$). The complication during surgery i.e. peritoneal tear was significantly higher in patients with BMI >30 ($p < 0.015$).

CONCLUSION

In this study, 70 patients underwent Stoppa's modified open pre-peritoneal prolene mesh hernioplasty. The strongest proponent of this method was Stoppa's who had initiated it in 1969 and it was popularized by Nyhus and his group, reported excellent results in terms of recurrence and complication rates specifically in hernias which were difficult to manage like recurrent/multirecurrent, Incisional and large inguinal hernias. This study was carried out with the aim to evaluate the operative outcome and complications of this procedure. Included in the study were mostly large Incisional, inguinal, umbilical and epigastric hernias. The study had significant modifications compared to the original procedure described by Stoppa in his publication like additional procedures of appendectomy and/or cholecystectomy where indicated, retro muscular dissection, mesh plugs for deep inguinal ring and ligation of inferior epigastric vessels. We operated on a wide range of age group (26-84 years) with male preponderance(63%).The maximum number of cases were of Incisional hernia(41%) followed by bilateral inguinal hernia(33%). Average operating time was 118min for Incisional and 90 min for Bilateral Inguinal hernias. During surgery the most common complication was peritoneal tear (27%). On table abdominal binder was mandatory. In the post op period patients were given epidural analgesia and ambulated early. We had complications of seroma in 07 patients, partial wound failure in 02 patients. None of the patients required removal of mesh due to infection. There were two recurrences; both had primary inguinal hernia. There were no major delayed complications. The recurrence rates and complications were similar to as reported in literature and the modifications had not adversely affected the outcome. The learning curve for this surgery is short, estimated to be around 05 surgeries. This procedure has certain inherent advantages like it avoids reopening through distorted anatomy in cases of recurrent hernia, permits inspection of all potential hernial sites. It is truly tensionless and sutureless repair.

Despite clear benefits and excellent results in management of difficult abdominal hernias, GPRVS is not adopted widely. In an estimate it was stated that <5% cases were managed by GPRVS. Reasons could be unfamiliarity with the approach, surgeons caught in "Ivory Tower Syndrome" where everybody knows where it is but nobody wants to go there. We would like to recommend Stoppa's repair based on our experience for recurrent and multi-recurrent abdominal hernias, large Incisional and bilateral inguinoscrotal hernia

The pre peritoneal space is a virgin space that is certainly intact during the conventional repair of hernias and this will be so till this space is virtually "over-run" by pre peritoneal repairers in the coming future. Till then, for all those few surgeons addicted to pre peritoneal repair, this God given wonderful space is for exploitation to ones heart's content and to the hilt!

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the institutional ethics committee

REFERENCES

1. Malangoni MA, Rosen MJ. Hernias. In: Townsend C.M, Beauchamp R.D, Sabiston textbook of surgery, 18th ed. Philadelphia. Saunders. 2008; 1155-1175.
2. Santora TA, Rosalyn JJ. Incisional hernia. Surg Clin North Am. 1993;73:557.

3. Patino JF. A history of the treatment of hernia. In: Nyhus LM, Condon RE. Hernia, 4th edition. Philadelphia. J.B.Lippincott. 1995;03-06.
4. Stoppa RE. The treatment of complicated groin and incisional hernia. World J Surg. 1989;13:545-54.
5. Rutkow IM, Robbins AW. Demographic, classificatory and socioeconomic aspects of hernia repair in the United States. Surg Clin North Am. 1993;73(3):413-26.
6. Rutkow IM. Epidemiologic, economic, and sociologic aspects of hernia surgery in the United States in the 1990s. Surg Clin North Am. 1998;78(6):941-51.
7. Katz DA. Evaluation and management of inguinal and umbilical hernias. Pediatr Ann. 2001;30(12):729-35.
8. Matthews RD, Neumayer L. Inguinal hernia in the 21st century: an evidence-based review. Curr Probl Surg. 2008;45(4):261-312.
9. Stoppa RE. Giant prosthesis for replacement of visceral sac in the repair of groin and incisional hernia. In Fisher JE, Bland KI. Master's of Surgery. 5th edition, Lippincott Williams and Wilkin's. 2007;1924-30.
10. Stopp RE. The preperitoneal approach and prosthetic repair of groin hernias. In: Nyhus LM, Condon RE. Hernia. 4th ed. Philadelphia. J. B. Lippincott. 1995;201-10.
11. Nyhus LM, Condon RE. Clinical experiences with preperitoneal hernia repair for all types of hernia of the groin. Am J Surg. 1990;100:234.
12. Sakorafas GH, Nissiotakis C. Open preperitoneal mesh repair of recurrent inguinal and femoral hernias. Mount Sinai J Med. 2005;72(5):342-4.
13. Stoppa RE, Rives JL, Warlaumont CR. The use of dacron in the repair of hernias of the groin. Surg Clin North Am. 1984;64:269.
14. Rodrigues AJ, Yoo JH. The stoppa procedure in inguinal hernia repair to drain or not to drain. Rev Hosp Clin Fac Med Paulo. 2003;58(2):97-102.
15. Lauwers P, Bracke B. Unusual complication of preperitoneal mesh implantation in the treatment of inguinal hernia-case report. Acta Chir Belg. 2003;103:5163-4.
16. Stoppa R, Ralamiaramanana F, Henry X. Evolution of large ventral incisional repair: the French contribution to a difficult problem. Hernia. 1999;3:1.
17. Stoppa R. Giant prosthetic reinforcement of visceral sac. Hernia. 1993:404-6.
18. Bauer JJ, Harris MT. Rives stoppa procedure for repair of large Incisional hernia. Hernia. 2002;6:120-3.
19. Stoppa RE. The treatment of complicated groin and Incisional hernia. World J Surg. 1989;13:545-54.
20. Lowham AS, Filipi CJ. Mechanism of hernia recurrence after preperitoneal mesh repair. Annsurg. 2007;225(4):422-31.
21. Heartsill L, Richards ML. Open rives stoppa ventral hernia repair made simple and successful but not for everyone. Hernia. 2005;9:162-6.
22. Kurzer M, Belsham PA. Prospective study of open preperitoneal mesh repair for recurrent inguinal hernia. Br J Surg. 2002;89:90-3.
23. Eklund A, Montogmery A. Short term result of randomized clinical trial comparing Lichtenstein open hernia repair with laparoscopic extraperitoneal hernia repair.Br J Surg. 2006;93:1060-8.
24. Eklund A, Montogmery. Low recurrence rate after laparoscopic and open inguinal hernia repair. A randomized multicentre trial. Ann Surg. 2009;249:33-8.

Cite this article as: Ray MS, Deepak BS. Stoppa's modified, open preperitoneal prolene mesh hernioplasty: a critical analysis of operative outcome in 70 cases. Int Surg J 2017;4:348-55.