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Original Article

Comparison of Outcomes between Lightweight and Heavyweight Meshes in Open Inguinal Hernia Surgery: A Prospective Study of 60 Cases in Our Standard

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Abstract

Introduction: The principle of modern open hernia surgery is tension-free mesh repair. The choice of mesh component varies from surgeon to surgeon and depends on patient factors. This study was aimed at identifying the benefit of lightweight polypropylene meshes for open inguinal hernia surgery over the heavyweight ones.

Methods: A one-year prospective observational study from 1st January 2022 to 31st December 2022 was conducted to identify the effects of both lightweight and heavyweight meshes. The patients were interviewed on follow-ups up to one year after surgery and different aspects of health related to this surgery were assessed single-blindly.

Results: Higher score in the HRQoL (Health Related Quality of Life) in the light-weight mesh group suggest that lightweight mesh provides better overall satisfaction with the patient's experience, improved post-operative recovery and well-being. Alternatively heavyweight mesh cohort rarely achieved full satisfaction during one-year follow-up in the physical and mental health domains.

Conclusion: HWM had a distinctive advantage over LWM with regard to recurrence. The two types of prosthetic meshes had equivalent outcomes for postoperative pain, seroma, foreign body sensation, infection, and numbness. Studies focused on defect sizes and fixation methods are warranted for further stratification.

Keywords: Inguinal hernia, Hernioplasty, Lightweight mesh (LWM), Heavyweight mesh (HWM), HRQoL (Health Related Quality of Life).

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Introduction

Inguinal hernia repair remains one of the most frequently performed operations globally, with millions of procedures carried out each year. [1,2] In practice, there is a considerable worldwide variation regarding the surgical techniques. There is a range of materials that have been used for hernia repair, from cotton, silk sutures to more modern options like nylon, polyester, and polytetrafluoroethylene. Earlier repair materials were limited by issues such as infection risk, pronounced foreign body response, tissue hardening, and gradual loss of structural strength, giving rise to recurrence of the hernia over time.[3,4] In 1959, F. Usher developed a knitted mesh in polyethylene which is the forerunner of polypropylene. It displayed better

integration of collagen probably due to the increased fibroblast activity, and an overall improved strength of the system. [5] The polypropylene mesh has greatly reduced the recurrence rate following hernia repair surgery.

However, there is a never-ending discussion among the surgeons about the polypropylene mesh regarding its expected properties like weight. Polypropylene meshes are commonly grouped by density, with lightweight varieties typically under 60 g/m² and heavyweight options generally exceeding 70 g/m².[6] HWM meshes were preferred initially due to their apparent physical durability. But concerns raised over time regarding the chronic pain, foreign body reaction and stiffness in the operative area, leading the surgeons to seek some other options like an LWM.

The LWMs are produced with fine filaments with large pore sizes, usually more than 1 mm. They present a balance between the decreased foreign body reaction and tissue integration which were lacking in the HWMs.[7] There are numerous studies regarding the use of LWM and HWM, providing important insights evaluating the clinical outcomes, postoperative complications and recurrence, [8, 9,10] although the association between usage of LWM and recurrence is unclear.

Our aim in this study is to conduct a comprehensive evaluation of the advantages and disadvantages associated with both LWM and HWM, their impact over postoperative comfort and overall health related quality of life (HRQoL).

Materials and methods

A prospective observational study was carried out from 1st January 2022 to 31st December 2022 on 60 patients undergoing elective open inguinal hernia surgery with mesh repair to assess health related quality of life between two groups who were randomly divided to receive lightweight and heavyweight meshes. The study cohort included adult patients who underwent elective open inguinal hernia surgery with mesh repair under spinal anaesthesia.

Patient selection

Adult patients with inguinal hernia who underwent elective surgery and consenting for open inguinal hernia repair with mesh having body mass index 18.5 – 29.9 were included in this study. Those with recurrent hernia, recent pregnancy, sepsis, emergency surgery, postoperative wound infection (SSSI or Deep SSI) were all excluded from this study cohort.

Data collection

Patients' data were collected from hospital records, like demography (age, sex), hernial site, symptoms, and comorbidities (cardiovascular disease, bronchial asthma, chronic obstructive airway disease, chronic kidney disease, constipation, history of smoking, obstructive sleep apnoea syndrome, features of benign prostatic hyperplasia etc.). Clinical details like the size of the hernial defect (based on the EHS inguino-femoral classification),[2,11] symptoms and presentations were recorded. Surgical details like length of the procedure, size of the mesh implanted and the type (LWM or HWM) were also obtained from the medical records. Patients were advised for either 95g/m^2 of HWM or 34-36 g/m^2 of LWM alternatively and recorded. It was a single-blinded study where the patient did not know the type of mesh. Data regarding postoperative length of hospital stay, any complication, recurrence and HRQoL were gathered on a systematic data collection sheet.

Health-related quality of life assessment

Health-related quality of life following inguinal hernia repair was measured utilizing the short SF-36 form focusing on the physical functioning status, role constraints, physical discomfort, general health, social functioning and emotional issues. The score range was from 0 to 100. Only 19 patients filled up the form at different intervals of the follow-up, as one month later, three months later and after one year.

Follow-up

Follow-ups were scheduled for this study at one month, three months and one year post-operatively. They were followed up at the outdoor on regular basis and asked for various health-related issues. A physical examination of the operative site and comprehensive review of the patient's detailed medical history were part of normal follow-up protocol. The final study population did not include patients who were lost from follow-up. An ultrasound of the local part was sometimes warranted where there was suspicion of any localized wound complication, like collection, recurrence etc.

Surgical procedure

All the surgeries were carried out under subarachnoid blockade using 0.5% Bupivacaine (heavy). All the

surgeries were not performed by the same senior surgeon, although the same technical care-points were achieved.

The surgical technique (Lichtenstein tension-free mesh repair) involved dividing the external oblique aponeurosis along the line of incision, gaining access to the inguinal canal and its contents. The primary pathology was then ascertained whether it was a medial (direct) or lateral (indirect) hernia. In case of direct hernia, the sac was then freed from the surrounding structures like internal oblique muscle, transversus abdominis and inguinal ligament. Then a per string suture was applied around its neck reducing the size of the funiculus (Table-2). There was no attempt at opening of the direct hernial sac. Again, in case it was an indirect hernia, the sac along with its contents were dissected carefully away from the spermatic cord. Then the sac was opened, the contents reduced and, in some cases, it was necessary to partly excise the omentum for handling with comfort. In none of the cases there was a resection of gut. Then the sac was transfixed at the level of the deep ring with a per string suture and the redundant part excised. The posterior wall of the inguinal canal was then ready for implantation of the prolene mesh. A few of the cases had both direct and indirect components identified on exploration, which were dealt with accordingly as direct and indirect ones separately. Space was then created to accommodate the mesh (usually 7.5cmx15cm) on all dimensions. The predetermined (it was none of the per-operative findings, presence of pantaloon hernia, complete disruption of fascia transversalis or gross weakness of the posterior wall muscles that determined the type of mesh) prolene mesh – lightweight or heavyweight was then placed aseptically avoiding any contact with skin surface, the lateral end was split-open partly to accommodate the journey of the spermatic cord. It was fixed initially to the prepubic fibrous tissue with a single stitch. Then medially up to about 3 cm medially (to avoid risk of recurrence and development of femoral hernia later) and fixed to the internal oblique aponeurosis with interrupted stitches. The fixation of the lower border of the mesh to the exposed inguinal ligament was with interrupted stitches of prolene and the emerging spermatic cord was snug-fixed with the fish-tailing of the lateral split segment of the mesh. The periphery of the mesh was fixed with interrupted stitches. All attempts were made to identify, dissect and secure the ilio-inguinal nerve, ilio-hypogastric nerve and genital branch of the genitofemoral nerves throughout the procedure. It was made sure that no fixation of prolene was causing an entrapment of the nerves. The external oblique aponeurosis was then closed from lateral to medial with continuous suturing, leaving a gap on the medial aspect for the exit of the spermatic cord. No hernia mesh plug was used in any case. Skin edges were apposed with staples (Table-III).

Statistical analysis

Descriptive statistics, including means, standard deviations, frequencies, percentages were used to summarize the results of outcome among the study population and demography. Categorical variables were compared using chi-square tests or Fisher's exact tests as appropriate. The statistical significance was set at $p<0.05$.

Results

A total of 110 patients undergoing elective open inguinal hernia surgery were initially included to this prospective study where 50 patients were lost from a one-year follow up. Finally, the inclusion criteria were met by only 60 patients, all of whom were males, all 4 female patients were lost from the follow-up. Patient's age range was 18-76 years (Table -I). Among the patients, left sided hernia was 45% and right sided hernia was slightly more (52%), while some had bilateral hernia (3%) (Fig-1). Among these patients, 63% of patients had some symptoms. There was no noticeable variation in outcome due to the comorbidities like BMI, cardiac status, respiratory issues or diabetes. About 15% patients had previous surgery on the contralateral side and most of them have presented within the subsequent decade. 28 patients received lightweight mesh while 32 received heavyweight meshes (Fig.-2) on the single-blinded method and the subjective outcomes were followed on subsequent follow ups at the outpatient department on scheduled basis.

There was no case that underwent intestinal resection and the average time for surgery was 68 minutes in heavy-weight meshes and 75 minutes in cases of lightweight meshes. There is a trend of more time consumption in case of lightweight meshes, probably due to easy surfacing physical property of the heavy mesh.

Table I: *Demography*

Age	Male (n=60)	Female (n=0)
18-30	9 (15.0%)	0
31-50	15 (25.0%)	0
51-76	36 (60.0%)	0

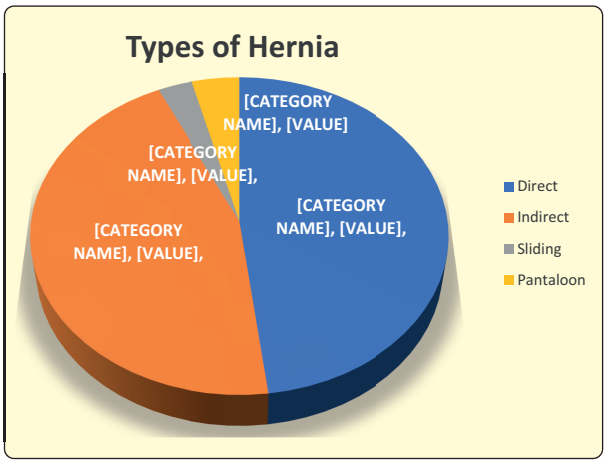

Fig. 1: *Type of hernia*

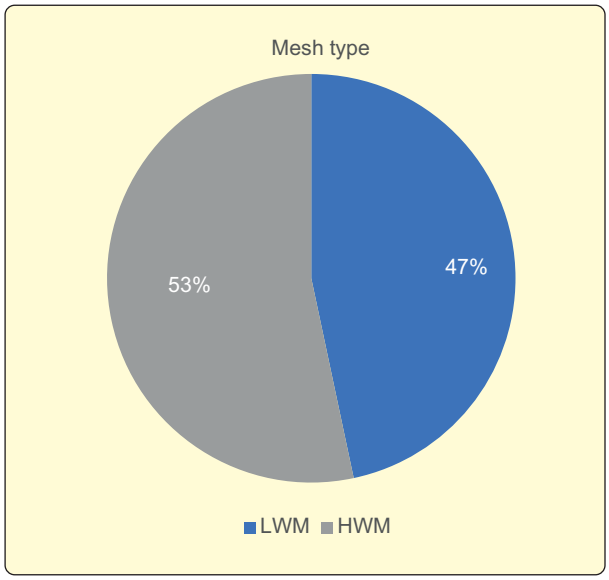

Fig. 2: *Number of patients receiving different types of meshes:*

Table II: Size of the defect

	LWM (n=28)	HWM (n=32)	*p*
Size of hernial defect according to EHS			
1	12 (42.8%)	9 (28.1%)	
2	8 (28.5%)	10 (31.2%)	0.76
3	8 (28.5%)	13 (40.6%)	

Table III: Per operative data

	LWM (minute)	HWM (minute)
Operating time		
(Skin to skin)	75	68
Range	63 – 85	60 – 73

Table IV: *Postoperative course:*

	LWM (n=28)%	HWM (n=32)%
Post operative length of hospital stay	0 (0%)	2 (6.2%)
10-day patient discomfort score (VApS)	6	8
10-day wound seroma formation	0 (0%)	1 (3.1%)
10-day wound haematoma	1 (3.5%)	2 (6.2%)
10-day daily life disturbance	0 (0%)	1 (3.1%)
10-day sleep disturbance	1 (3.5%)	2 (6.2%)
Perincisional paresthesia	5 (17.8%)	8 (25.0%)
3-month feeling of stiffness	1 (3.5%)	3 (9.3%)
3-month hernia recurrence	0 (0%)	1 (3.1%)

It has been found in this study that placement of a lightweight mesh is not difficult; it can be more appropriate for the defect shape and easy postoperative course. The heavyweight meshes, on the other hand, have good physical characteristics that allow the defect to surface easily, but the postoperative course is noticeable. Some (6.2%) patients need to stay in the postoperative period longer than one day to minimize the pain to a tolerable level, some (9.3%) notice stiffness, heaviness and foreign-

body feeling after weeks, and some have developed wound complications like wound seroma (3.1%) and wound haematoma (6.2%) (Table-IV).

A Visual Analogue Pain Scale ((VApS)[12] was used to score the level of pain the patient experienced over the first 10 postoperative days. Sutures and staples were removed on the 10th postoperative day in all cases. The median values for LWM and HWM were 6 and 8, respectively. Seroma developed in some 3.1% cases in the HWM group and none in the LWM group. None of the patients had any sign of surgical site infection while examining the wound during the removal of the stitches or staples. A few patients had developed urinary retention in the immediate postoperative period, which was relieved by urethral catheterization; this can be explained by the effect of spinal anaesthesia, and none of them had any new ongoing urinary symptoms.

Regular common drugs were used for postoperative pain management. Patients usually returned to their daily activities within the next 1-2 days. Most of them joined their service within the next 6 days on average in the HWM group and 4 days in the LWM group. Patients returned to their daily activities within next 1-2 days. It was regarded as walking, dining, taking shower, wearing clothes on his own etc. The duration of analgesic requirement on SOS basis was 4 days in the LWM group ranging from 3 to 7 days; while it was considerably longer in the HWM group, 8 days, the range being 6 to 12 days (Table-V).

Patients in the LWM group reported sleep disturbances for the first 2 postoperative days, while it was 4 days in case of HWM group. The feedback was taken on the 10th postoperative day. Sleep disturbance was considered as any disruption in a patient's regular sleep patterns (insomnia, non-restorative sleep, delayed sleep onset, or fragmented sleep).

The SF-36 questionnaire form was used to assess the postoperative physical and mental health status of a patient encompassing 36 items across 8 different health domains. On the one-month follow-up, the LWM group of the cohort showed a lot better well-being than those with the HWM. The one-year follow-up survey by SF-36 form interestingly showed no significant difference between the two groups although LWM groups showed fewer functional limitations, greater social and emotional wellbeing, reduced discomfort, and better overall health (Table-VI).

No recurrence was noted in either group during the one-year follow-up.

Interestingly, there is no significant difference in the long-term follow-up between the groups.

Table V: Postoperative quality of life

	LWM (n=28) days	HWM (n=32) days
Return to daily activity	1	1
Return to job	4 (range 3-8)	6 (range 4-9)
Analgesics required postoperatively	4	8
Sleep disturbance	2	4

Table VI: *Follow-up table*

	LWM group (n=28)		HWM group (n=32)	
	30 days	12 months	30 days	12 months
Physical functioning	86%	99%	76%	91%
Role physical	91%	99%	76%	76%
Pain at the Operative site	71%	91%	66%	78.6%
General health	81%	91%	76%	76%
Vitality	76%	81%	66%	66%
Social functioning	66%	76%	61%	76%
Role emotional	91%	99%	91%	99%
Mental health	86%	93%	76%	81%
Reported health	71%	76%	71%	76%

Discussion

The use of polypropylene mesh in inguinal hernia surgery has become very imperative over the last few decades. There are several types as stated before. They show excellent tensile strength and stretch. Despite their well-known use, the HWM cohort in this study show noticeable postoperative wound stiffness, pain, discomfort, late return to daily activities and high HRQoL using the SF-36 form, comparing those parameters with the LWM cohort, even for several months [13,14]. A randomized clinical trial, on a similar cohort of patients underwent unilateral primary inguinal hernia via the Lichtenstein technique, confirmed that fewer patients in the LWM group reported numbness around the groin or along the thigh after surgery, whereas with no differences in chronic pain incidence and recurrence rate.[15]

This study had few main strengths; the same standard surgical techniques and principles were followed in all the cases and the same level of senior surgeons operated on all the patients. Again, the type of mesh was single blinded to the patients and their reports were not influenced by the surgeons' choice. Compounding bias was eliminated by the use of a similar type of regular analgesics in all the cases and the same antibiotic regimen.

Lightweight meshes often offer practical benefits, including better flexibility and a reduced tendency to cause postoperative stiffness or a foreign body sensation. According to Smedberg et al. the placement of either mesh does not affect short-term complications, with comparable rates of postoperative pain, as well as the occurrence of wound hematoma and seroma.[16]

It is important to note that the HWM group noticed (HRQoL) delayed return to daily activities, return to job, more feeling of stiffness and sleep disturbances; although there is no significant difference between the two groups in one-year follow-ups.

Higher score in the HRQoL in the LWM group suggest that LWM provides better overall satisfaction with the patient's experience, improved post-operative recovery and well-being. Alternatively HWM cohort rarely achieved full satisfaction during one-year follow-up in the physical and mental health domains. Indeed, this finding is consistent with previous literature and with the biologic-functional role of the prosthesis as a scaffold for the development of the fibrosis necessary for the containment and long-term resolution of hernia disease.[17]

Recent pooled analyses indicate that recurrence rates are comparable between lightweight and heavyweight polypropylene meshes, contradicting the notion that there is a higher incidence of recurrence due to the smaller amount of material in the LW-PP mesh.[18] An important role in influencing recurrence is played by mesh shrinkage. The percentage of mesh shrinkage is highly variable, depending on the material, structure, geometry, and direction of the mesh.[19] Jerabek et al. describe how the implantation of a polypropylene mesh with a pore size of 3 mm is associated with a significant reduction in shrinkage compared to a mesh with a pore size of 1 mm and a mesh with a pore size of 0.5 mm.[20] Meanwhile, Silvestre et al. concluded that shrinkage was significantly higher for HW-PP, although the difference was not large.[21]

It is increasingly being emphasized in the scientific community that considering individual patient features, such as age, comorbidities, and frailty status, as well as hernia characteristics, when selecting the appropriate mesh type.[22] Customizing mesh selection based on patient-specific factors may help to optimize outcomes and minimize postoperative complications.[23,24]

Conclusion

Our study has few limitations. First, its single-center study may have the possibility of selection bias and incomplete data. Secondly, the limited sample size may require validation in a larger cohort. Varities of fixation techniques were not addressed in this study. Again, analgesic consumption could provide misleading conclusion regarding the experience of pain [25]. Further studies involving larger patient groups and extended follow up are needed to clarify these findings more definitively [26].

Conflict of interest

Author Dr. Mohammad Faroque Eastiak, Dr. Abu Nur Md. Masud Rana, Dr. Md. Shahidul Islam, Dr. Mohammad Salim and Dr. Md. Faysal Kamal declare that they have no conflict of interest.

Human and animal rights: this article involves ill human subjects with no more than minimal risk.

Informed consent: informed written consent was obtained from each of the cohort.

The authors declare that this study conforms to the Declaration of Helsinki.

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