ABSTRACT

Introduction: The use of all synthetic material in inguinal hernia repair has remained in controversy regarding their effects on the gonads in the young adult male. Infertility may result from intra-operative factors such as injury to cord structures or due to postoperative factors such as fibroblastic reaction induced by the mesh. Polypropylene mesh is commonly used in Lichtenstein repair owing to its good mechanical stability, optimal fixation and incorporation of the prosthesis in the abdominal wall. Our study intends to review the safety profile of the bilateral Lichtenstein inguinal hernia repair with polypropylene mesh on male gonadal function.

Materials and Methods: A prospective analytical study with a total of 86 male patients with bilateral uncomplicated reducible inguinal hernia between 18 and 60 years of age with normal gonadal function presenting at our tertiary care centre was done over 3 years. Patients underwent bilateral Lichtenstein repair with polypropylene mesh and were evaluated preoperatively as well as postoperatively with inguino-scrotal Color Doppler Ultrasonography (CDUS) and serum hormone profile. Results: There was no significant difference found in either testicular volume by CDUS in 2nd week, 8th week, & 6th month postoperatively as compared to pre-operative values. A significant increase in TARI in both testes was found at 2nd post-op week which levelled by 8th week and at 6th month postoperatively. There was no statistically significant difference between pre-op and 2nd post-op week serum FSH & LH levels. However there was a significant rise in 8th post-op week and 6th month serum FSH & LH levels, although the rise wasn’t clinically significant.

Discussion: Previous studies on inguinal hernia repair using polypropylene mesh suggested that it could lead to an alteration in testicular blood flow; as a result of compression either by severe mesh induced fibrosis around cord or any other mechanical obstruction and lead to infertility/ subfertility esp. with bilateral inguinal mesh repair. Our study, however, shows no clinically significant change in spermatic cord structures, testicular volume, perfusion or any change in hormonal profile indicative of subfertility/ infertility after bilateral open Lichtenstein meshplasty.

Key Words: CDUS: Color Doppler Ultrasonography, FSH: Follicular Stimulating Hormone, LH: Luteinizing Hormone and TARI: Testicular Artery Resistive Index

INTRODUCTION

The use of synthetic mesh in inguinal hernia repair has remained in controversy on account of their effect on male gonadal function, particularly in the young adults. Lichtenstein inguinal hernia repair has proved, over years, to be a safe, easily reproducible and cost-effective tension-free technique with advantages of low recurrence rate, fast postoperative recovery, and low incidence of chronic postoperative pain and high level of patient satisfaction (Shulman et al., 1995; Fitzgibbons, 2001).

The incidence of infertility among patients operated for inguinal hernias (overall) has been shown to be greater than in the general population (Shin et al., 2005). Infertility has been proposed to result from intraoperative or postoperative factors. Intraoperative factors include injury to vascular supply and to the vas deferens itself. Postoperative factor includes the fibroblastic reaction induced by the mesh, which intuitively affects the spermatic cord, which lies anterior to it. It has been shown that there is a significant decrease in the cross-sectional diameter of vas and a marked foreign body reaction to the mesh in the tissue surrounding the spermatic cord (Shin et al., 2005).

Our study intends to review the safety profile of the bilateral Lichtenstein inguinal hernia repair with polypropylene mesh on male gonadal function in terms of testicular volume, perfusion, and serum hormone profile as well as to identify the high risk group prone to gonadal dysfunction.

MATERIALS AND METHODS

A prospective analytical study with a total of 86 male patients with bilateral uncomplicated reducible inguinal hernia (irrespective of type) between 18 and 60 years of age with normal gonadal function presenting to the surgical OPD of Dr. RML Hospital, Delhi was done between October 2012 and May 2015.
Patients were evaluated preoperatively as well as postoperatively (2nd week, 2 months and 6 months postoperatively) by clinical method, inguino-scrotal CDUS (with evaluation of testicular volume, resistive indices of testicular arteries, as well as evaluation of the inguinal hernia) and serum hormone profile (FSH, LH, and testosterone levels).

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\text{Testicular volume (mm}^3\) = height (mm) \times width (mm) \times length (mm) \times 0.71 \] (Sakamoto et al., 2007)

All the patients underwent the standardized Lichtenstein procedure by the same surgeon in the department who had >10 years of experience in Lichtenstein tension free repair with polypropylene mesh under spinal anesthesia with identical perioperative care and surgical technique. Any case with intra-operative complication such as inadvertent diathermy injury, cord injury was excluded. Statistical analysis of the data was performed using SPSS software and using Paired t test. Statistical significance is defined if the p value was < 0.05.

RESULTS

All 86 male patients included in our study were of the age group 18 – 60 years and had bilateral inguinal hernias. The type of hernia in our study was predominantly indirect inguinal hernia (71.25%) with rest of direct type (28.75%).

Table 1: Pre and Post-Operative Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pre-operative (mean +/- 2sd)</th>
<th>Post-op (2nd week) (mean +/- 2sd)</th>
<th>Post-op (8th week) (mean +/- 2sd)</th>
<th>Post-op 6 months (mean +/- 2sd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lt Testicular Volume (mm³)</td>
<td>18.7926 +/- 2*(1.94788)</td>
<td>18.7937 +/- 2*(1.94617)</td>
<td>18.8147 +/- 2*(1.96099)</td>
<td>18.8090 +/- 2*(1.96191)</td>
</tr>
<tr>
<td>Rt Testicular Volume (mm³)</td>
<td>18.4670 +/- 2*(1.85620)</td>
<td>18.4688 +/- 2*(1.85453)</td>
<td>18.4610 +/- 2*(1.81983)</td>
<td>18.4465 +/- 2*(1.84292)</td>
</tr>
<tr>
<td>RI (Left testicular a.)</td>
<td>.5391 +/- 2*(.0444)</td>
<td>.5969 +/- 2*(.0679)</td>
<td>.5347 +/- 2*(.037)</td>
<td>.537 +/- 2*(.0450)</td>
</tr>
<tr>
<td>RI (Right testicular a.)</td>
<td>.53 +/- 2*(.0444)</td>
<td>.63 +/- 2*(.0685)</td>
<td>.53 +/- 2*(.04083)</td>
<td>.53 +/- 2*(.04357)</td>
</tr>
<tr>
<td>FSH uIU/ml</td>
<td>6.4231 +/- 2*(.51266)</td>
<td>6.3634 +/- 2*(.43270)</td>
<td>6.3634 +/- 2*(.64414)</td>
<td>7.0547 +/- 2*(.67267)</td>
</tr>
<tr>
<td>LH uIU/ml</td>
<td>5.1393 +/- 2*(.51340)</td>
<td>5.1430 +/- 2*(.48307)</td>
<td>5.9802 +/- 2*(.68134)</td>
<td>5.9815 +/- 2*(.66593)</td>
</tr>
<tr>
<td>Testosterone (ng/ml)</td>
<td>21.9809 +/- 2*(2.362)</td>
<td>22.0016 +/- 2*(2.311)</td>
<td>21.4728 +/- 2*(2.191)</td>
<td>21.5871 +/- 2*(2.175)</td>
</tr>
</tbody>
</table>

There was no statistically significant difference of Right testicular volume by CDUS at 2nd week (P=0.995), 8th week (P=0.983), and 6th month (P=0.942) postoperatively compared to preoperative values. Similarly, no statistically significant difference of Left testicular volume by CDUS at 2nd week (P=0.997), 8th week (P=0.941), and 6th month (P=0.956) postoperatively.

Around 78 (90.69%) patients had increased TARI on Right side at 2nd post-op week (P=0.000). There was no significant effect of Lichtenstein repair on TARI found at 8th week (P=0.939), and 6th month of follow up (P=0.738) postoperatively. On the Left side around 63 (73.25%) patients had increased TARI at 2nd post-op week (P=0.000). There was no significant effect of Lichtenstein repair on TARI at 8th week (P=0.563), and 6th month of postoperative follow up (P=0.563).

There was no statistically significant difference of serum FSH levels between pre-op and post-op 2nd week (P=0.495). However, there was significant increase in FSH levels at 8th post-op week in 70 patients (81.39%) (P=0.000) and after 6 months of follow up in 70 patients (81.39%) (P=0.000). Similarly, there was no significant difference in serum LH level in 2nd postoperative week (P=0.967) compared to preoperative values. But there was significant increase in serum LH levels observed at 8th postoperative week (P=0.000) in 64 patients (74.4%), and at 6th month in 58 patients (67.44%). No significant difference in serum testosterone pre-op and post-op 2nd (P=0.952), 8th (P=0.142) week and after 6th month of follow up (P=0.254) was noted.

DISCUSSION

The use of polypropylene mesh in Lichtenstein repair of hernia has remained controversial particularly in males in the reproductive age group, owing to speculations on its effect on gonadal function based on conflicting reports in various studies. The concern of gonadal dysfunction increases in cases of bilateral inguinal hernia repairs.

Hernia in young adults is usually of indirect type (75 -90%). Incidence of bilateral inguinal hernia has been reported to range from 6-35% in different studies with bilateral indirect inguinal hernias accounting up to 56% of this cases.
In indirect inguinal hernia the proximity of sac with cord structures increases chance of mechanical injury to cord structures following hernia repair. Because most inguinal hernias are unilateral, younger men rarely face sterility. Patients of bilateral hernia are more prone to get gonadal dysfunction secondary to mesh induced fibrosis (Peeters et al., 2010). Preserving testicular volume and function is crucial in hernia surgery which requires the maintenance of arterial circulation (Skandalakis et al., 1996 and Read, 2004). Use of prostheses is fundamental for obtaining low recurrence and high satisfaction rates in inguinal hernia repair (Shulman et al., 1995 and Zieren et al, 2001). Polypropylene mesh induces an acute inflammatory reaction followed by chronic foreign body fibroblastic response giving rise to extensive scar tissue which imparts strength to implantation area. The reaction seems to strengthen the floor of the inguinal canal and to decrease the incidence of recurrence (Junge et al., 2008). However, it also induces adhesion and tissue attachments surrounding the inguinal cord or vas and may lead to its obstruction, which may result in subfertility/infertility. Mesh is composed of inert materials, yet, over time, mesh contracts, and this contraction may cause congestion in the plexus pampiniformis. Moreover, the sharp edges of the mesh can erode the spermatic cord (Silich & McSherry, 1996). Obstructive azoospermia can also be caused by intraoperative damage of the vas during dissection, suturing, or use of electrocoagulation, injuring and occluding the vas deferens (Uzzo et al., 1999 and Yavetz et al., 1991).

Shin et al., (2005) reported obstructive azoospermia in 14 patients following surgical correction of hernia using prostheses and concluded that before undergoing polypropylene mesh repair, men, especially of young reproductive age need to be carefully advised of potential compromise of future fertility (Blouchos et al., 2012). Incidence of testicular atrophy following inguinal hernia repair (with or without mesh) has been reported to range from 1%-14% in various studies Homonnai et al., (1980) Wantz (1982 & 1983) Fong and Wantz (1992) and Beddy et al., (2006). Studies on inguinal hernia repair using polypropylene mesh have suggested it could lead to an alteration in testicular blood flow, as a result of compression either by severe mesh induced fibrosis around cord or any other mechanical obstruction (Piotr et al., 2007 and Goldenberg et al., 2005).

Animal studies have shown histological changes, reduction in the spermatogenesis and an inflammatory process involving the vas deferens in majority of the animals which underwent inguinal hernia repair with polypropylene mesh (Peiper et al., 2006; Tekatli et al., 2012; Goldenberg et al., 2001 and Maciel et al., 2007). In patients re-operated after previous prosthetic hernia repairs, there is found foreign-body reaction, granuloma formation, fibrinoid necrosis in some cases and extensive collagen deposits around the prostheses which leads to contraction of the prosthesis (reduction to 60% of its original size) (Taylor et al., 2001 and Aydede et al, 2003).Taylor et al., (2001) however, showed that mesh contraction following inguinal repair does not adversely affect the testes or femoral vessels, concluding that mesh can be used safely.

The site of prosthesis placement has major repercussions, with placement of the prosthesis in the pre-peritoneal position having more effect on RI than the Lichtenstein technique. Supporting evidence by Akbulut et al showed significant changes in testicular volume and serum testosterone levels with TEP as compared to Lichtenstein repair (Akbulut et al., 2003 and Bendavid, 2004). The protection given to the elements of the spermatic funiculus by the cremaster muscle has been cited as one advantage of the Lichtenstein procedure in relation to other techniques in which the prosthesis remains in contact with vessels and nerves (Magnus et al., 2012).

In other studies there was no significant difference found between pre op and post op testicular volume, or any evidence of vascular compromise after inguinal hernia mesh repair. If fibrosis occurs it usually does not completely obstruct the testicular vessels. So testicular volume usually remains unchanged after surgery (Durmus et al., 2005; Lima et al., 2007; Pinggera & Agner, 2008; Sucullu et al., 2010 and Junge et al., 2011).

In our study we observed no significant difference between values of Right testicular mean volume pre-op and post-op 2nd week (p=0.995), 8th week (p=0.983), and 6 months (p=0.942) postoperatively. Similarly there was no significant difference of Left testicular volume in pre-op and post-op 2nd week (p=0.997), 8th week (p=0.941), and at 6 months (p=0.956) post operatively.

The best and widely used way for assessing the testicular volume and testicular function is by measuring the RI (RI = (peak systolic velocity - end diastolic velocity) / peak systolic velocity). The normal range of resistive index is 0.45-0.60. RI ≥0.60 in testicular artery is considered pathognomonic, suggestive of an increase in vascular impedance. A decrease in diastolic blood flow with an increase in the RI identifies testicular ischemia (Pavlica & Barozzi, 2001). Uzzo et al found testicular perfusion to be reduced significantly in patients undergoing both Lichtenstein as well as Shouldice repairs.In contrast in rest studies no significant alteration in testicular artery flow velocities and RI could be found following Lichtenstein hernia repair (Dilek et al., 2005 and Schouten et al., 2012). Sucullu et al., (2010) found elevated RI in early postoperative period following both the Lichtenstein (P=0.027) and mesh plug repair of inguinal hernia (P=0.012).
In our study around 78 patients (90.69%) had increased RI in Right testis at 2
d post-op week (p=0.000) but there was no significant change in RI at 8
week (p=0.939), and 6th month (p=0.738) postoperatively, as compared to pre
op values. 63 patients (73.25%) had increased RI in Left testis at 2nd post-op week (p=0.000) but no significant
change in RI could be seen at 8th week (p=0.563), and 6 months (p=0.867 ) postoperatively.
The increase in RI in the early post-operative period has been attributed to handling of cord during sac dissection,
which temporarily reduces testicular blood flow. Gradually it is overcome and testicular flow becomes normal in late
post-operative period (Pinggera & Agner, 2008; Turgut et al., 2007; Fong & Wantz, 1992 and Zunge et al.,
2008).
On serum hormonal profile, we found no significant difference (p=0.495) between pre-op and 2nd post-op week of
serum FSH level but there was significant increase in serum FSH (although within normal limits) measured at 8th
week (p=0.000) in 70 patients (81.39%) and 6th month postoperatively (p=0.000). Similarly, there was no
statistically significant difference (p=0.967) between pre-op and 2nd post-op week of serum LH level but again a
significant change was noted in 8th post-op week (p=0.000) among 64 patients (74.41%) and after 6 months in 58
patients (67.44%) (p=0.000). Despite the significant increase in mean FSH and LH after 8 weeks and 6th month post-
operatively, the absolute values were well within the normal limits and this requires further studies with larger
sample size. There was no significant change in serum testosterone levels measured pre-op, post-op 2nd week
(p=0.952), 8th week (p=0.142), and 6th month (p=0.254) postoperatively after Lichtenstein repair.
Thus our study shows no clinically significant change in spermatogenic cord structures, testicular volume, perfusion or
any change in hormonal profile indicative of subfertility or infertility after bilateral open Lichtenstein meshplasty.
So we conclude that bilateral Lichtenstein repair with polypropylene mesh is safe in terms of effect on fertility in
male patients in reproductive age group although larger randomized studies and longer follow up are required to
establish its safety.

CONCLUSION
Lichtenstein repair in bilateral inguinal hernia has been in controversy in respect to its effect on male gonadal
function particularly in the reproductive age group. Our studies shows that there is no significant change in the male
gonadal functions except there is significant change in the values of serum FSH and LH in respect of its preoperative
mean values although the change in serum FSH and LH level is well within the normal limit. This change may be
due to some changes in the testosterone level although not significant but a further study on largest sample size is
needed to substantiate the cause of increase of serum FSH and LH level.

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