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Original Research Article

STUDY OF ALTERATION IN TESTICULAR PERFUSION AFTER LICHTENSTEIN HERNIA REPAIR

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ABSTRACT

Background: Inguinal hernia repair, particularly the Lichtenstein tension-free mesh repair, is one of the most commonly performed general surgical procedures worldwide. While highly effective, concerns remain regarding its potential impact on testicular perfusion due to mesh placement and manipulation of spermatic cord structures during surgery. The present study was undertaken to evaluate alterations in testicular perfusion following Lichtenstein hernia repair using Doppler ultrasonography as a non-invasive assessment tool.

Materials and Methods: This prospective observational study was conducted over a period of 18 months and included adult male patients undergoing elective unilateral Lichtenstein inguinal hernia repair. Patients with bilateral hernias, recurrent hernias, or pre-existing testicular disorders were excluded. Testicular perfusion was assessed preoperatively and at postoperative intervals (1 week and 3 months) using color Doppler ultrasonography, evaluating parameters such as resistive index (RI), peak systolic velocity (PSV), and end diastolic velocity (EDV).

Results: A total of 60 patients were enrolled. Preoperative Doppler studies demonstrated normal testicular perfusion parameters. Postoperative assessments revealed a transient increase in resistive index and decrease in diastolic flow at 1-week follow-up, suggestive of mild perfusion changes. However, at 3-month evaluation, Doppler parameters largely returned to baseline values, indicating restoration of testicular blood flow. No significant long-term alterations in testicular perfusion were observed.

Conclusion: Lichtenstein hernia repair may cause transient alterations in testicular perfusion in the immediate postoperative period, but long-term testicular blood flow remains largely unaffected. Doppler ultrasonography serves as a reliable, non-invasive tool for monitoring testicular perfusion following inguinal hernia surgery.

Keywords: Inguinal hernia repair, Lichtenstein mesh repair, testicular perfusion, Doppler ultrasonography, resistive index, spermatic cord.

INTRODUCTION

Inguinal hernia repair stands as one of the most frequently performed surgical procedures worldwide, particularly among the male population where lifetime incidence can reach up to 27%. The introduction of the Lichtenstein tension-free mesh repair has revolutionized hernia surgery by providing a simple, effective, and reproducible technique with significantly reduced recurrence rates and postoperative complications. Its widespread adoption across surgical practice globally is attributed to its technical ease, minimal learning curve, early patient mobilization, and consistently favorable long-term outcomes.[1,2]

However, despite the success of the Lichtenstein technique in addressing hernia recurrence, concerns persist regarding the potential implications of mesh placement on the surrounding vital structures within the inguinal canal.[3] During the repair, careful dissection and manipulation are required around the spermatic cord, which contains critical anatomical components including the testicular artery, pampiniform venous plexus, lymphatics, vas

deferens, and associated nerves.[4] Surgical handling, inadvertent trauma, edema, fibrosis, or mesh-induced foreign body reaction may potentially impair testicular vascular supply either acutely or chronically, raising concerns over compromised testicular perfusion, function, and long-term reproductive health.[5]

The testicular artery plays a crucial role in maintaining testicular viability, spermatogenesis, and hormonal function. Any compromise in arterial inflow or venous drainage may result in tissue hypoxia, ischemia-reperfusion injury, venous congestion, or chronic inflammatory response, which over time could lead to testicular atrophy, impaired fertility, scrotal discomfort, or chronic orchialgia. Though these complications are not routinely encountered, their potential occurrence carries significant implications for younger patients and those desiring future fertility, thus warranting careful scientific evaluation.[6,7]

With the advancement of imaging modalities, color Doppler ultrasonography has emerged as a non-invasive, readily available, and highly sensitive technique for evaluating testicular perfusion. It allows real-time visualization of both arterial and venous flow and provides objective quantitative measurements such as peak systolic velocity (PSV), end diastolic velocity (EDV), and resistive index (RI).[8] These parameters offer precise information about intratesticular hemodynamics and can detect even subtle alterations in vascular resistance, congestion, or ischemia. Doppler assessment both preoperatively and at serial intervals postoperatively provides an excellent means of monitoring any potential vascular compromise following inguinal hernia repair.[9,10]

Existing literature presents conflicting observations regarding the effect of Lichtenstein hernia repair on testicular perfusion. While some studies suggest transient perfusion alterations in the early postoperative phase due to edema or inflammatory response, most report normalization of flow over time without significant long-term compromise. However, variations in patient selection, surgical technique, mesh characteristics, and follow-up protocols across studies limit the generalizability of these findings. Therefore, continuous scientific evaluation remains necessary to establish robust evidence regarding testicular vascular safety following mesh repair.[11,12]

In view of these considerations, the present study was undertaken to evaluate the alterations in testicular perfusion following Lichtenstein tension-free mesh repair using color Doppler ultrasonography. Through detailed assessment of vascular parameters both preoperatively and at scheduled postoperative intervals, the study aims to objectively determine whether the Lichtenstein technique poses any significant risk to testicular blood flow and to contribute valuable data towards optimizing surgical decision-making and patient counseling.

MATERIALS AND METHODS

This prospective observational study was conducted over a period of 18 months in the Department of General Surgery at a tertiary care teaching hospital. The study enrolled adult male patients diagnosed with primary unilateral inguinal hernia who were scheduled to undergo elective Lichtenstein tension-free mesh hernioplasty. Prior written informed consent was obtained from all participants after explaining the study objectives, procedures, and potential risks.

Inclusion criteria comprised adult male patients aged between 18 and 60 years presenting with uncomplicated, primary unilateral inguinal hernia. Patients with bilateral hernias, recurrent hernias, incarcerated or strangulated hernias, and those with any pre-existing testicular pathology such as varicocele, hydrocele, orchitis, undescended testis, or prior scrotal surgery were excluded from the study. Patients with systemic diseases known to affect vascularity such as diabetes mellitus, peripheral vascular disease, or known cardiovascular disorders were also excluded to avoid confounding factors.

All patients underwent a detailed clinical evaluation, including complete history taking and physical examination. Baseline laboratory investigations were performed to assess fitness for anesthesia and surgery. Preoperative scrotal evaluation was performed using high-resolution color Doppler ultrasonography by an experienced radiologist to document baseline testicular perfusion parameters. The sonographic assessment included evaluation of testicular size, echotexture, and vascular flow patterns. The key Doppler parameters recorded were peak systolic velocity (PSV), end diastolic velocity (EDV), and resistive index (RI) for both the intratesticular and capsular branches of the testicular artery.

All surgical procedures were performed under spinal anesthesia by experienced surgeons following a standardized operative protocol. The Lichtenstein tension-free mesh repair was carried out using a polypropylene mesh placed over the posterior wall of the inguinal canal after careful dissection of the hernial sac and minimal handling of the spermatic cord structures. Hemostasis was meticulously secured to prevent hematoma formation. Postoperative analgesia was provided as per institutional protocol, and all patients were closely monitored during their hospital stay.

Postoperative Doppler ultrasonography assessments were performed at two intervals: on postoperative day 7 and at 3 months follow-up. The same radiologist who performed the preoperative scans conducted the postoperative evaluations to maintain consistency in measurements. Any alterations in PSV, EDV, and RI were carefully documented and compared with baseline values to assess any changes in testicular perfusion following surgery.

All collected data were compiled in a structured database and subjected to statistical analysis. Continuous variables were expressed as mean ± standard deviation, while categorical data were presented as percentages. Comparative analysis between preoperative and postoperative Doppler parameters was performed using paired t-tests and repeated measures ANOVA, as appropriate. A p-value of <0.05 was considered statistically significant.

Ethical clearance for the study was obtained from the Institutional Ethics Committee prior to commencement, and all study procedures were conducted in accordance with the ethical principles outlined in the Declaration of Helsinki.

RESULTS

A total of 60 adult male patients undergoing elective unilateral Lichtenstein inguinal hernia repair were included in the study. The mean age of the study population was 42.6 ± 10.8 years, with the majority of patients (65%) belonging to the 30–50 year age group. Right-sided hernia was more common, observed in 66.7% of cases, while 33.3% had left-sided hernia. All patients tolerated the surgical procedure well without any major intraoperative or early postoperative complications. Preoperative color Doppler ultrasonography demonstrated normal testicular perfusion parameters in all patients. Postoperative assessments revealed transient alterations in testicular blood flow parameters at the 1-week follow-up, characterized by a mild increase in resistive index (RI) and a corresponding decrease in end diastolic velocity (EDV), suggestive of temporary perfusion changes. However, at 3-month follow-up, Doppler parameters showed a near-complete return to baseline values in the majority of patients, indicating restoration of normal testicular perfusion following surgery.

[Table 1] shows the distribution of patients according to their age groups.

Table 1: Age Distribution of Study Participants

Age Group (years)	Number of Patients	Percentage (%)
18–30	10	16.7
31–40	20	33.3
41–50	19	31.7
51–60	11	18.3
Total	60	100

[Table 2] shows the side of hernia occurrence in the study population.

Table 2: Laterality of Inguinal Hernia

Side Involved	Number of Patients	Percentage (%)
Right	40	66.7
Left	20	33.3
Total	60	100

[Table 3] demonstrates the type of hernia observed during surgery.

Table 3: Type of Hernia Identified Intraoperatively

Type of Hernia	Number of Patients	Percentage (%)
Indirect	36	60.0
Direct	18	30.0
Pantaloon	6	10.0
Total	60	100

[Table 4] summarizes the baseline Doppler parameters recorded before surgery.

Table 4: Preoperative Doppler Parameters of Testicular Perfusion

Doppler Parameter	Mean ± SD
Peak Systolic Velocity (PSV, cm/s)	12.4 ± 1.8
End Diastolic Velocity (EDV, cm/s)	4.1 ± 0.6
Resistive Index (RI)	0.67 ± 0.04

[Table 5] presents the Doppler perfusion changes observed one week after surgery.

Table 5: Postoperative Doppler Parameters at 1-Week Follow-up

Doppler Parameter	Mean ± SD
Peak Systolic Velocity (PSV, cm/s)	11.9 ± 2.0
End Diastolic Velocity (EDV, cm/s)	3.5 ± 0.5
Resistive Index (RI)	0.71 ± 0.05

[Table 6] shows the testicular perfusion parameters recorded at 3 months postoperatively.

Table 6: Postoperative Doppler Parameters at 3-Month Follow-up

Doppler Parameter	Mean ± SD
Peak Systolic Velocity (PSV, cm/s)	12.2 ± 1.7
End Diastolic Velocity (EDV, cm/s)	4.0 ± 0.5
Resistive Index (RI)	0.68 ± 0.03

[Table 7] compares RI measurements before surgery, at 1 week, and at 3 months.

Table 7: Comparison of Resistive Index Across Different Time Points

Time Point	RI (Mean ± SD)
Preoperative	0.67 ± 0.04
1 Week Postoperative	0.71 ± 0.05
3 Months Postoperative	0.68 ± 0.03

[Table 8] presents the comparison of EDV values at different follow-up intervals.

Table 8: Comparison of End Diastolic Velocity Across Different Time Points

Time Point	EDV (cm/s) (Mean ± SD)
Preoperative	4.1 ± 0.6
1 Week Postoperative	3.5 ± 0.5
3 Months Postoperative	4.0 ± 0.5

[Table 9] demonstrates the comparison of PSV measurements over time.

Table 9: Comparison of Peak Systolic Velocity Across Different Time Points

Time Point	PSV (cm/s) (Mean ± SD)
Preoperative	12.4 ± 1.8
1 Week Postoperative	11.9 ± 2.0
3 Months Postoperative	12.2 ± 1.7

[Table 10] summarizes statistical analysis of RI changes between time points.

Table 10: Statistical Significance of Changes in Resistive Index

Comparison	p-value
Preoperative vs 1 Week	0.002
Preoperative vs 3 Months	0.09
1 Week vs 3 Months	0.015

[Table 11] summarizes statistical analysis of EDV changes between time points.

Table 11: Statistical Significance of Changes in End Diastolic Velocity

Comparison	p-value
Preoperative vs 1 Week	0.004
Preoperative vs 3 Months	0.12
1 Week vs 3 Months	0.020

[Table 12] summarizes statistical analysis of PSV changes between time points.

Table 12: Statistical Significance of Changes in Peak Systolic Velocity

Comparison	p-value
Preoperative vs 1 Week	0.065
Preoperative vs 3 Months	0.48
1 Week vs 3 Months	0.072

[Table 1] demonstrated that the majority of patients belonged to the 31–50 year age group. [Table 2] showed right-sided hernia predominance. [Table 3] indicated that indirect hernia was the most common intraoperative finding. [Tables 4 – 6] presented the Doppler perfusion parameters across preoperative, 1-week, and 3-month intervals. [Tables 7-9] compared changes in RI, EDV, and PSV over time, demonstrating transient changes postoperatively that returned toward baseline by 3 months. [Tables 10-12] showed statistically significant transient changes in RI and EDV at 1 week, with nonsignificant differences by 3 months, while changes in PSV were not statistically significant across all intervals.

DISCUSSION

The present study was undertaken to evaluate the potential impact of Lichtenstein tension-free mesh repair on testicular perfusion in adult male patients with unilateral inguinal hernia, using color Doppler ultrasonography as a non-invasive assessment tool.

The findings provide valuable insights into the temporal changes in testicular blood flow following surgery and contribute to the ongoing discussion regarding the vascular safety of this widely practiced surgical technique.[13]

Inguinal hernia remains one of the most common general surgical conditions, with the Lichtenstein mesh repair considered the gold standard due to its simplicity, durability, and low recurrence rates. However, given the proximity of the spermatic cord and testicular vasculature to the operative field, there has always been theoretical concern that surgical manipulation, mesh placement, and subsequent fibrosis may compromise testicular blood flow, leading to complications such as ischemia, venous congestion, testicular atrophy, or subfertility. Although these complications are uncommon, their clinical significance warrants careful evaluation, especially in younger men concerned with reproductive health.[14] The majority of patients were middle-aged, with right-sided hernia being more frequently encountered, which is consistent with established epidemiological trends. Indirect hernias accounted for the most common intraoperative finding, reflecting the anatomical predisposition of the inguinal canal for such defects.[15]

The use of Doppler ultrasonography provided objective quantification of testicular perfusion, measuring parameters such as resistive index (RI), peak systolic velocity (PSV), and end diastolic velocity (EDV). Preoperative assessments confirmed normal perfusion patterns across all patients, establishing a reliable baseline for postoperative comparisons.[16]

Postoperative evaluation at 1-week follow-up demonstrated statistically significant transient alterations in testicular blood flow, as reflected by an increase in RI and corresponding decrease in EDV. These changes are likely attributable to transient postoperative edema, localized inflammatory response, or temporary mechanical effects related to tissue handling and mesh placement during surgery. Such early changes are not uncommon following surgical intervention and may represent a physiological adaptation rather than true vascular compromise.[17,18]

Importantly, by 3-month follow-up, the majority of Doppler parameters, including RI, EDV, and PSV, had returned to levels comparable to preoperative values, with no significant long-term alterations observed. The transient nature of these changes suggests that while Lichtenstein repair may temporarily affect testicular perfusion in the immediate postoperative period, compensatory mechanisms restore vascular homeostasis as tissue healing and resolution of inflammation occur over time.[19]

The absence of significant long-term impairment in testicular blood flow reinforces the vascular safety of the Lichtenstein technique when performed with meticulous dissection and proper surgical technique. Preservation of the integrity of the spermatic cord structures, avoidance of excessive traction, careful mesh placement, and gentle tissue handling are critical intraoperative considerations that likely contribute to favorable vascular outcomes.[20]

The findings of this study are consistent with existing literature that suggests minor, reversible hemodynamic changes may occur early postoperatively but do not translate into sustained vascular compromise. The data also emphasize the value of Doppler ultrasonography as a sensitive, non-invasive tool for monitoring subtle vascular changes and reassuring both surgeons and patients about the safety profile of mesh hernioplasty.

Overall, this study supports the conclusion that Lichtenstein hernia repair remains a safe and effective procedure without significant long-term adverse effects on testicular perfusion, provided that proper surgical principles are adhered to.

CONCLUSION

The present study demonstrates that Lichtenstein tension-free mesh repair for unilateral inguinal hernia may cause transient alterations in testicular perfusion during the early postoperative period, as evidenced by temporary changes in resistive index and diastolic flow on Doppler ultrasonography. However, these hemodynamic changes were reversible, with testicular blood flow returning to near-baseline levels within 3 months post-surgery. No long-term vascular compromise or clinically significant testicular dysfunction was observed in any patient. The findings reaffirm the vascular safety of Lichtenstein hernia repair when performed with meticulous technique, while highlighting the utility of Doppler ultrasonography as an effective, non-invasive monitoring tool in the postoperative setting.

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