

Original Research Article

Study of testicular perfusion after Lichtenstein hernioplasty in uncomplicated inguinal hernia

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ABSTRACT

Background: Inguinal hernia repair is one of the most commonly performed surgical procedures in the world. The aim is to achieve a recurrence free hernia repair with minimum of complications. In mesh inguinal hernia repair testicular cord structures are in direct contact with the mesh. Testicular ischemia usually manifests within 48-72 hours after surgery. Aims of the study was to assess any changes in perfusion of ipsilateral testis after Lichtenstein hernioplasty and establish a baseline testicular perfusion pattern in the study population. This study was conducted in the Department of Surgery for one year at a tertiary care teaching hospital in Delhi.

Methods: All consenting adult male patients undergoing Lichtenstein inguinal hernioplasty for unilateral inguinal hernia fulfilling the inclusion and exclusion criteria. A sample size of 50 was included in study.

Results: In this study patients were above 18 and below 60 years of age with mean age of 43.58 years. The paired T-test analysis revealed no statistically significant difference between pre and post-operative values of SV, DV, RI, PI and TV.

Conclusions: Lichtenstein tension free mesh repair for uncomplicated inguinal hernia does not impair testicular perfusion after the procedure.

Keywords: Lichtenstein hernioplasty, Testicular perfusion, Testicular ischemia

INTRODUCTION

An inguinal hernia is a protrusion of parietal peritoneum, 'the peritoneal sac', through a preformed or secondarily established defect in the inguinal area of the abdominal wall.¹ According to Fruchaud hypothesis 'the main fundamental cause of all groin hernia is failure of the fascia transversalis to retain the peritoneum'.² About 10% of people develop some type of hernia during their lifetime.³

Inguinal hernia repair is one of the most commonly performed surgical procedures in the world.⁴ The aim of the hernia surgery is to achieve a recurrence free hernia repair with minimum of complications. Lichtenstein

hernioplasty for inguinal hernia is considered the gold standard and is recommended by the European Hernia Society.⁵ World-wide nearly one million inguinal hernia surgical repairs are performed annually with prosthetic mesh mainly with polypropylene.^{6,7}

In mesh inguinal hernia repair testicular cord structures are in direct contact with the mesh (Figure 1). Fibrotic healing causes hardening and shrinkage of the mesh and can carry the risk of impaired testicular perfusion. Studies show the testicular ischemia leading to testicular atrophy to be around 0-2%.^{3,4,8,9} Testicular ischemia usually manifests within 48-72 hours after surgery.^{3,10} Color doppler ultrasonography is the best method for evaluating

testicular perfusion for testicular pathology and in patient with inguinal hernia.¹¹⁻¹³

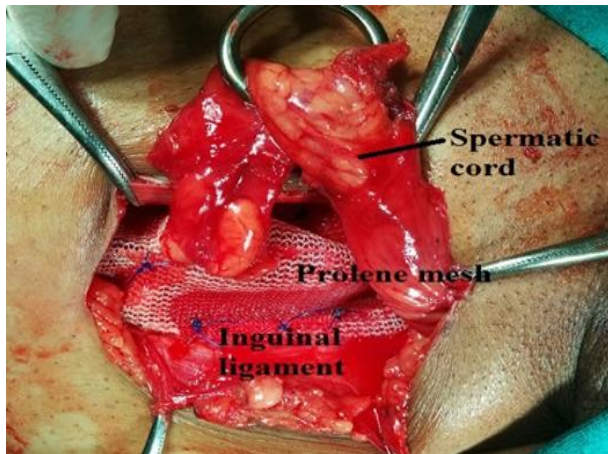


Figure 1: Mesh fixed behind the spermatic cord.

The present study was designed to detect changes in testicular perfusion and testicular volume in patients undergoing Lichtenstein hernioplasty for uncomplicated inguinal hernia.

Aims of the study was to asses any changes in perfusion of ipsilateral testis after Lichtenstein hernioplasty and establish a baseline testicular perfusion pattern in the study population.

METHODS

The present study was conducted in the Department of General Surgery in a tertiary care hospital in Delhi conducted for 2 years duration between 2014 to 2016. The study design was done prospective cross-sectional study.

A sample size of minimum 31 cases is needed. However, considering attrition and to improve power of study a sample size of 50 was included in study.

formula for cross sectional studies = $\frac{Z^2 \times p \times q}{d^2}$

All consenting adult male patients undergoing Lichtenstein inguinal hernioplasty for unilateral inguinal hernia fulfilling the inclusion and exclusion criteria.

Inclusion criteria

- Uncomplicated inguinal hernia.
- Age more than 18 years.
- Willingly giving consent to be part of the study.

Exclusion criteria

- Complicated inguinal hernia (irreducible/ obstructed/ strangulated/recurrent)

- Bilateral inguinal hernia
- Patients with past operations of scrotum, testicles or prostate.
- Uncontrolled bleeding diathesis.
- Patients with inguinal or scrotal injury/orchitis/funiculitis during post-operative period of three months will be excluded in final analysis.
- Hernia with hydrocele.

Data collection

Patient characteristics, as per inclusion and exclusion criteria, including age, type, nature and duration of hernia, any history of previous inguinal-scrotal/testicular operations, history of any comorbidities/coexisting conditions like hypertension, diabetes mellitus, personal history, operative notes and findings as well as color Doppler ultrasonography details were recorded and maintained as per the study performa.

All patients underwent standard Lichtenstein inguinal hernioplasty under spinal anesthesia, after a thorough preoperative assessment of the patient. Informed consent was taken from all patients before the surgery.

Color doppler ultrasonography

Patients underwent color doppler ultrasonography scan of cord blood vessels and testicular perfusion assessed using Phillips iE-33 machine with a linear color Doppler multi frequency 3-11Mhz transducer. It was done one day prior to surgery, third day after surgery and third month after surgery. Parameters recorded include testicular volume, systolic velocity, diastolic velocity, resistive index, pulsatility index, presence or absence of intra luminal clot/obstruction (Figure 2).



Figure 2: Color doppler assessing a) Testicular volume b) Testicular perfusion.

Follow-up phase

All patients were asked to follow up at post-operative 3rd day and at 3rd month (90th day) after operation. Color

doppler ultrasound was done for testicular perfusion parameters were noted.

Table 1: Color doppler parameters.

Variable	Pre-operative	Post operative day 3 rd		Post-operative day 90 th	
	Mean	Mean	P value	Mean	P value
Systolic velocity	19.87±5.06	19.72±4.81	0.786	19.398±3.94	0.195
Diastolic velocity	7.23±1.86	7.32±1.81	0.714	7.14±1.66	0.639
Resistance index	0.72±.078	.71±.092	0.535	.72±.075	0.776
Pulsatility index	1.16±.31	1.11±.24	0.150	1.11±1.56	0.105
Testicular volume	17.69±3.88	18.00±3.63	0.389	17.76±3.63	0.800

Statistical analysis

Descriptive statistics analyzed with SPSS version 17.0 software. Continuous variables presented as Mean±SD. Categorical variables were expressed as frequencies and percentages. The comparison of normally distributed continuous variables pre and post operatively performed using Paired t-test. For all statistical tests, a p value less than 0.05 taken to indicate a significant difference.

RESULTS

This present prospective cross-sectional study was conducted on 50 patients to evaluate the testicular perfusion and testicular volume by color doppler ultrasound one day prior to surgery (Pre-operatively) and post-operative on day 3 (early post-operative) and on day 90 (late postoperative).

Patient characteristics

In this study patients were above 18 and below 60 years of age with mean age of 43.58 years. 34% (n=17) were in the age group of 41-50 years. There were 29 (58%) right sided and 21 (42%) left sided hernias. In 21 (42%) participants were found to have direct and 29 (58%) had indirect inguinal hernia. 13 (26%) participants were found to have bubonocoele, 25 (50%) funicular and 12 (24%) had complete type of inguinal hernia. Fourteen (28%) hernias were of less than one-year duration, 17 (34%) between one and two years, 19 (38%) were of more than 2 years duration. Eight (16%) had DM and 7 (14%) had hypertension and 21 (42%) participants were smokers as coexisting conditions. Wound seroma in 5 (10%) patients, wound hematoma in 2 (4%) patients and urinary retention in 10 (20%) were the post-operative complications recorded.

Color doppler ultrasound parameters

The mean systolic velocity decreased on post-operative day 3 (19.72±4.81) and on day 90 (19.398±3.94). Mean diastolic velocity increased on post-operative day 3 (7.32±1.81) and decreased on post-operative day 90

(7.14±1.66). Whereas mean resistance index value decreased on post-operative day 3 and become normal on day 90. Mean pulsatility index value decreased on post-operative day 3 and on day 90. Testicular volume was found to increase on post-operative day 3 and on day 90. The paired T-test analysis revealed no statistically significant difference between pre and post-operative values of SV, DV, RI, PI and TV. The data is tabulated in Table 1.

Color doppler ultrasound parameters in relation to type of hernia**Bubonocoele type of hernia**

There was increase in mean value of systolic velocity on post-operative day 3 (19.08) and decreased on post-operative day 90 (18.62). Whereas mean diastolic velocity decreased on post-operative day 3 and increased on day 90 in comparison to pre-operative value.

The mean values of resistance index, pulsatility index and testicular volume increased on post-operative day 3 and on day 90. On paired T-test analysis there were no statistically significant difference between pre and post-operative values of SV, DV, RI, PI and TV.

Funicular type of hernia

The mean values of systolic velocity, testicular volume and pulsatility index decreased on post-operative day 3 and day 90. Whereas, mean diastolic velocity increased on post-operative day 3 (6.89) and decreased by day 90 (7.41) but was more than the pre-operative value (7.08). Mean resistance index decreased on post-operative day 3 and normalized on day 90. On paired T-test analysis there were no statistically significant difference between pre and post-operative values SV, DV, RI, PI, and TV.

Complete type of hernia

The mean values of systolic and diastolic velocity rates, resistance index was decreased on post-operative day 3 and on day 90. Mean pulsatility index decreased on post-

operative day 3 and increased on day 30. Where testicular volume increased on post-operative day 3 and on day 90. However, on paired T-test analysis there were no statistically significant difference between pre and post-operative values of SV, DV, RI, PI and TV.

Color doppler ultrasound parameters in relation to post-operative complication

There was no statistically significant difference between pre and post-operative values of SV, DV, RI, PI and TV.

Baseline parameters

In current study patients underwent color doppler ultrasound for studies of testicular perfusion parameters (SV, DV, RI and PI) and testicular volume were recorded preoperatively one day prior to surgery and on post-operatively on day 3 and on day 90. For this study preoperative data are taken as baseline parameters in the study population. Systolic velocity ranged from 12.60cm/sec to 27.6cm/sec, diastolic velocity had 2.39cm/sec to 10.10cm/sec, resistance index had a range of 0.54 to 0.88 and pulsatility index were from 0.90 to 2.83. Testicular volume ranged from 9.5 to 26.75ml pre-operatively (Table 2).

Table 2: Baseline parameters.

Variable / range	Pre-operative		
	Min	Max	Average
Systolic velocity (cm/sec)	12.60	27.6	19.87±5.06
Diastolic velocity (cm/sec)	2.39	10.10	7.23±1.86
Resistance index	0.54	0.88	0.72±0.078
Pulsatility index	0.90	2.83	1.16±0.315
Testicular volume (ml)	9.5	26.75	17.69±3.88

DISCUSSION

Total 50 patients with clinical diagnosis of uncomplicated inguinal hernia undergoing Lichtenstein hernioplasty using polypropylene mesh were enrolled in this study.

The perfusion of ipsilateral testicles of each patient was evaluated by color doppler ultrasound pre-operatively one day prior to surgery and post-operative on day 3 (early post-operative) and day 90 (late postoperative).

Number of patients

The present study included 50 patients with uncomplicated inguinal hernia. There were other studies with enrolled patients ranging from 26 to 64. There were 39 patients present in Edgar et al, 64 in Suculla I et al, 40 in Sinan Hatipoglu et al, 32 in Neset et al, 26 in Dilek et al study.^{10,12-15}

Table 3: Average age in different studies.

Study	Mean age	Age group (years)
Edgar et al ¹⁰	49.6	>21
Dilek et al ¹⁵	TEP group= 46.7	24-77
	LHR group= 54.2	
Neset et al ¹⁴	TEP group=54.4	33-69
	LHR group=52.5	42-72
Suculla I et al ¹²	LG=22	22-28
	MPG=23	20-30
Hatipoglu S et al ¹³	APMR group=31.40	20-45
	LHR group=36.76	
Current study	43.58	18-60

Mean age

All the patients enrolled in this study were between 18 and 60 years of age. Mean age of the patients in current study was 43.58 years. The highest incidence of inguinal hernia (66%) was found between the age group 41 to 60 years. 49.6 year was the mean age of patients in the series published by Edgar et al, Dilek et al reported mean age as 46.7 years (TEP group) and 54.2 years (LHR group).^{10,15} Similarly, 54.2 years (TEP group) and 52.2 years (LHR group) by Neset et al, and 22 years (LG group) and 23 years (MPG group) by Suculla I et al.^{12,14} Table 3 shows the mean age distribution in various studies

Testicular perfusion

Systolic velocity and diastolic velocity

The arterial flow of the testicles is fundamental for maintaining testicular volume and function.¹⁶ The testicular artery is the principal source of nutrition for testicles, and its diameter may reach 1.5mm.¹⁷ The diastolic velocity is cited as an important parameter for diagnosing severe arterial occlusions. Stenosis in which the vessel diameter is reduced by more than 70%, diastolic velocity increases, but with total occlusion the velocity drops to zero.¹⁸

In the present study there was decrease in mean systolic velocity on post-operative day 90 (19.38) compared to the recorded pre-operative value. Similar results of decrease in mean values of SV were observed by Edgar et al and Dilek et al on post-operative day 90 (18.58 and 17.38).^{10,15} However, the difference was not statistically significant in either of the studies (p-value 0.195 of current study) (Table 4).

The mean values of diastolic velocity decreased on post-operative day 90 (7.14) compared to pre-operative (7.23) value. Similar results of decrease in post-operative mean value was reported by Edgar et al (3.28) however study by Dilek et al reported increased on the 90 days value (5.71).^{10,15} The difference in values in all these studies

were not statistically significant (p-value 0.693 of current study).

Resistance index and pulsatility index

Elevated Resistance index is an important marker of ischemia in acute setting and pulsatility index is an important parameter for evaluating arterial stenosis. These indices are more representative for small-caliber vessels, since its calculation encompasses other values from the Doppler wave.

In the present study, the mean value of the resistance index preoperatively was 0.72 (SD±0.078) as well as on day 90, 0.72 (SD±0.0750). Similar results of mean pre and post-operative values of 0.6295 of RI were reported increased mean values of RI on post-operative day

90th.^{10,12,14,15,19} However, these differences were not statistically significant in either of the studies.

In present study pulsatility index mean value decreased on post-operative day 90 (1.11±1.56) with a p-value of 0.105. Eduardo et al observed increased mean value post-operative day 90 (2.48).¹⁹ These differences were not statistically significant.

Testicular volume

Testicular volume is an important marker for testicular atrophy following corrective surgical operations on patients with inguinal hernias.²⁰ The most important factor in preserving testicular volume and testicular function is the maintenance of the arterial circulation.

Table 4: Systolic velocity and diastolic velocity in other studies.

Study	SV pre-operative	SV post-operative day 90 th	DV pre-operative	DV post-operative day 90 th
Present study	19.87	19.398	7.23	7.14
Edgar et al ¹⁰	18.80	18.58	3.82	3.28
Dilek et al ¹⁵	17.30	17.24	5.51	5.71

Table 5: Resistance index and pulsatility index in other studies.

Study	RI pre-operative	RI post-operative day 90 th	PI pre-operative	PI post-operative day 90 th
Present study	0.72	0.72	1.16	1.11
Edgar et.al. ¹⁰	0.77	0.82	2.04	2.48
Dilek et al ¹⁵	0.65	0.66		
Neset et al ¹⁴	0.5806	0.5813		
I. Suculla et al ¹²	0.64	0.80		
Eduardo et al ¹⁹	0.6295	0.6295		

Table 6: Testicular volume in other studies.

Study	TV pre-operative	TV post-operative day 3 rd	TV post-operative day 60 th	TV post-operative day 90 th	TV post-operative 6 th month
Present study	17.69	18.00		17.76	
Edgar et al. ¹⁰	11.76			11.96	12.0
Suculla I et al ¹²	19.37			18.21	
Eduardo et al ¹⁹	16.44		17.45		17.07

Mean testicular volume (17.69) increased post-operatively on day 3 and 90 in the present study which were statistically insignificant (p-value 0.389 and 0.800 respectively). Edgar et al and Eduardo et al also reported increase in mean values on post-operatively day 60 (17.45) and day 90 (11.96) respectively.^{10,19} Decrease in mean value on post-operative day 90. However, these differences were not statistically significant in either of the studies.¹²

Testicular perfusion and volume according type of hernia

No statistically significant difference was found between the Doppler study parameters and types of hernia in the

current study population. Similar studies were not found on extensive literature search comparing the studied Doppler parameters with different types of hernia.

Testicular perfusion and volume according duration of hernia

No statistically significant difference was found between the Doppler study parameters and duration of hernia in current study patients.

Similar studies were not found on extensive literature search comparing the studied Doppler parameters with duration of hernia.

Testicular perfusion and volume according post-operative complication

In current study 17 patients had post-operative complication: urinary retention, wound seroma and wound hematoma. No statistically significant difference was found comparing pre and post-operative Doppler parameters with post-operative complications in current study.

Baseline parameters

Pre-operative values were taken as baseline parameters in this study. In current study peak systolic velocity ranged from 12.6 to 27.6cm/sec whereas Middleton et al reported 7.5 to 27.7cm/sec in supra testicular arteries, 5.0 to 23.4cm/sec in capsular arteries and 4.0 to 19.1 in intra testicular arteries.²¹ End diastolic velocity ranged from 2.39 to 10.10cm/sec where, Middleton et al reported 0 to 4.7cm/sec in supra testicular arteries, 1.8 to 9.2cm/sec in capsular arteries and 1.6 to 6.9 in intra testicular arteries.²¹ Resistance index ranged from 0.54 to 0.88. Where, Middleton et al reported 0.63 to 1.00 in supra testicular arteries, 0.46 to 0.78 in capsular arteries and 0.48 to 0.75 in intra testicular arteries.²¹ Pulsatility index ranged from 0.90 to 2.83. Where, Middleton et al reported 1.3 to 5.9 in supra testicular arteries, 0.82 to 2.30 in capsular arteries and 0.7 to 2.3 in intra-testicular arteries.²¹ In current study testicular volume ranges from 9.5 to 26.75ml pre-operatively.

CONCLUSION

Lichtenstein tension free mesh repair for uncomplicated inguinal hernia does not impair testicular perfusion after the procedure. There are no statistically significant changes in testicular blood flow and perfusion indices in patients of different age group, type of hernia, duration of hernia, post-operative complications, post-operative pain and VAS score, co morbidities/co existing conditions undergoing Lichtenstein tension free mesh repair with polypropylene mesh for uncomplicated inguinal hernia.

Lichtenstein tension free mesh repair with polypropylene mesh for uncomplicated inguinal hernia is a safe procedure. The study also establishes the baseline values of testicular perfusion indices and testicular volume in the study population.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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