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Original Article

How Lichtenstein hernia repair affects abdominal and anal resting pressures: a controlled clinical study

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Abstract: Purpose: Inguinal hernia repair is the most common surgical procedure performed by general surgeons worldwide. The Lichtenstein tension-free hernioplasty was first introduced in 1984 and evolved through 1988. Today it is the gold standard in hernia repair. The objective of this study was to determine if intra-abdominal and anal pressures changed in patients with inguinal hernias after Lichtenstein hernioplasties were performed. Materials and methods: A sample of 103 individuals, 92.2% of whom were male (n = 95) and 7.8% of whom were female (n = 8), aged 38.38 ± 14.03 years was used. The sample was divided into two groups: those with inguinal hernia (n = 53) and those without hernia (n = 50), who served as controls. Anal and abdominal manometric measurements were taken from each control patient at baseline and from each study patient before and after surgical repair. Results: Data analysis revealed differentiation of abdominal and anal pressures between the controls, the study patients before operation, and the study patients after operation. The average [SD] abdominal pressure was -2.58 mmHg [5.35] before hernia repair and 2.33 mmHG [3.62] after repair. The average [SD] abdominal pressure in the control group was 1.16 mmHg [1.96]. Conclusions: The Lichtenstein tension-free hernioplasty causes increases in abdominal and anal pressures, but this increase is not of a pathological level.

Keywords: Abdominal pressure, anal pressure, hernia, hernioplasty

Introduction

Inguinal hernia repair is a commonly performed general surgery procedure in both genders [1]. Bassini described his tissue repair method in 1887, and since then more than 70 types of pure tissue repair techniques have been defined. The most effective technique for inguinal hernia repair remains undetermined. Tension-free repair methods have been proven to be superior to tension-producing tissue repair procedures, however. A better understanding of the pathologic basis for inguinal hernia along with the higher recurrence rate and undesirable postoperative morbidities of tissue repair favored the concept of tension-free hernioplasty with mesh [2]. The Lichtenstein tension-free hernioplasty was introduced in 1984 and evolved through 1988. It is now considered the gold standard in hernia repair by the American College of Surgeons [3]. It provides good results with very low recurrence rates, even in recurrent cases, thus it has become a widely accepted method for hernia repair [4].

The advent of tension-free mesh hernioplasty has reduced the recurrence rate to 2-5% [5]. While recurrence is rare after mesh hernioplasty, it has the disadvantage of troublesome recurrent hernia operations because dense fibrotic reactive tissue surrounding the mesh can create complications such as testicular damage and surgical field hematoma [6]. The intense inflammatory response to the prosthetic material may result in scar plate formation, increased stiffness of the abdominal wall, and shrinkage of the biomaterial [7]. There are several complications associated with use of the prosthetic material including mesh contraction and migration, which may be due to a chronic inflammatory reaction to the prosthetic mesh or a loss of compliance after degradation of the material [8]. Postoperative chronic pain is the primary problem in hernia repair surgery with a reported incidence of 15-40% [9, 10].

Table 1. Patient Demographics

Variable	Patients Group N/%	Control Group N/%	P
No of Patients	53	50	
Age	*38.23 ± 14.035*	*38.54 ± 14.257*	*0.736*
Body weight	*73.49 ± 8.5*	*71.28 ± 8.9*	*0.202*
Male/sex (%)	*51 (96.2%)*	*44 (88.0%)*	*0.153*
Female sex (%)	*2 (3.8%)*	*6 (12.0%)*	

One objective of this study was to evaluate changes in the intra-abdominal and anal resting pressures due to a loss of local tissue elasticity from fibrotic scar tissue developed as a result of Lichtenstein hernioplasty. Another was to assess the relationship between this condition and patient complaints that continue into the postoperative period.

Materials and methods

A prospective controlled clinical study was conducted at Mengücek Gazi Training and Research Hospital in Erzincan, Turkey; from January 2012 to May 2013. This study was approved by the Ethics Committee of the Kafkas University of Kars and was performed according to the Declaration of Helsinki. Written informed consent was provided prior to enrollment, after explanation of the associated risks and benefits and description of the study protocol.

The inclusion criterion for non-control patient selection was a clinical history of inguinal hernia. Control group patients were selected from those who visited the clinic for symptoms not related to inguinal hernia. Exclusion criteria were senility, previous history of anal trauma, anal surgery, and diagnosis of a neurological disease. The sample was comprised of 103 individuals, 92.2% of whom were male (n = 95) and 7.8% of whom were female (n = 8). Non-control patients, those with a history of inguinal hernia, constituted Group 1 (G1) and the control group constituted Group 2 (G2). Gender distribution for G1 was 96.2 % (n = 51) male and 3.8% (n = 2) female while for G2 it was 88.8 % (n = 44) male and 12% (n = 6) female. Because anal sphincter tone declines with senility [11], patients over age 66 were not included in study.

Two patients' hernias were of type 1, 22 were of type 2, 13 were of type 3, and 7 were of type 4, according to the Gilbert Classification. Characteristics of the patients are given in **Table 1**. Abdominal and anal manometric measurements were obtained for all patients at baseline, and again six months postoperatively for G1.

Manometric testing was performed with a 9E-12-100A Menfis Biomedica 9-way catheter (Menfis bioMedica s.r.l. Bologna, Italy). All patients and controls underwent anal and abdominal manometry using a water perfused catheter with eight radially aligned channels attached to a hydraulic capillary infusion system (**Figures 1**, **2** and **3**). The 12F PVC catheter had an external diameter of 4 mm, an operative length of 100 cm, and a total length of 180 cm. It had one central lumen, 1.4 mm in diameter, which opened at the tip and four lumina which opened on the side, with diameters of 0.8 mm, radially arranged 3 cm from the tip. Four additional lumina opened along the side, 5 cm apart, along the length of the catheter in a helicoidal arrangement. Centimetric markings started at the last port. Before use, the device was calibrated on the same level as the patient. Examination was performed using a rapid pull-through technique with the patient in a supine right lateral position. The catheter was pulled by a mechanical device at a speed of 1 mm/sec.

Statistical analysis

SPSS 18.0 was used in the statistical analysis. Because variables were not distributed normally according to normality tests ($p < .05$), non-parametric tests were used. The Wilcoxon signed rank test was used to compare pressures and body mass indices (BMIs) between pre-operative and post-operative periods in G1. The Mann-Whitney test was used to compare manometric pressures between G1 and G2 and to determine if the groups differed in terms of age. A chi-square test (Fisher exact test) was used to determine if pressure varied by gender. The Kruskal-Wallis test was used to determine if manometric pressures varied by hernia type.

Results

There was no difference between the sexes (Fisher's exact test, p = 0.15). Age ranged from 20 to 66 years, averaging 38.38 ± 14.035 years. In G1 the range was 20 to 66 years averaging 38.23 ± 14.035 years while in G2 the range was 22 to 66 years averaging 38.54 ±

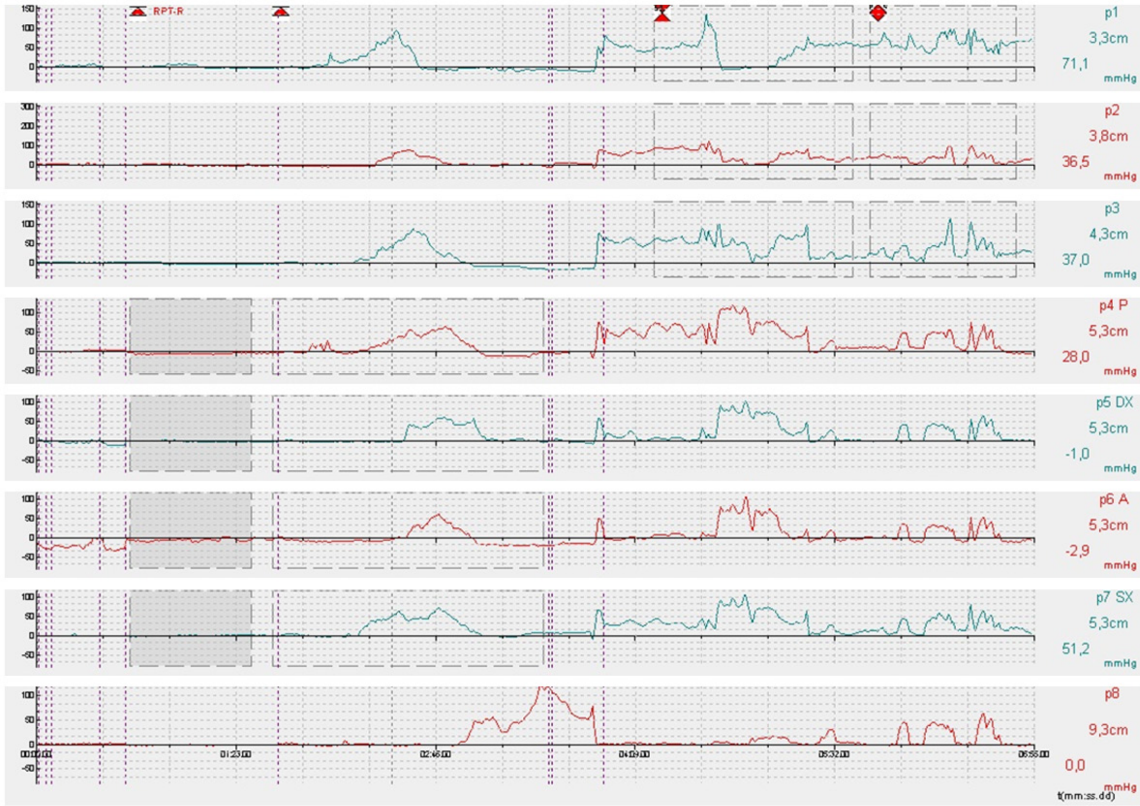

Figure 1. Graphic view of anal and abdominal manometric measurements of one patient. Anal and abdominal manometric measurements are seen on the same line. Abdominal pressure was obtained from the sigmoid colon; anal resting, squeezing, and pushing pressures were obtained on the anal sphincter complex after its location was determined by the rapid pull-through test.

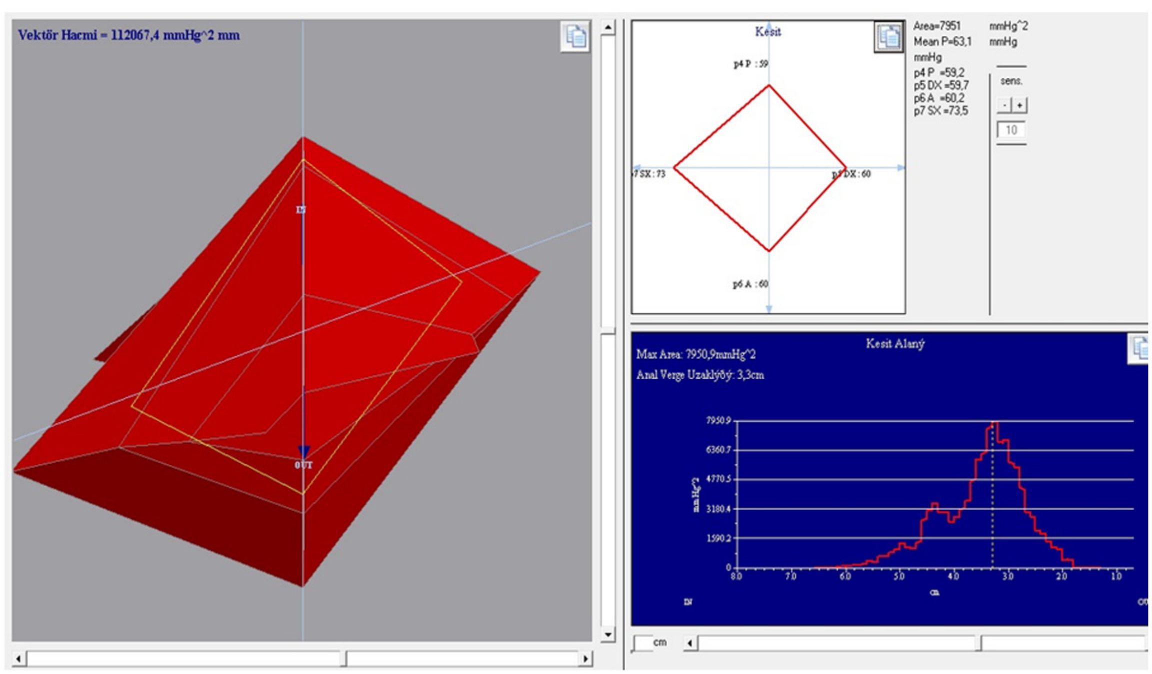

Figure 2. 3D vector volume assessment of one patient. This demonstrates the distribution of compression radially throughout the anal sphincter complex.

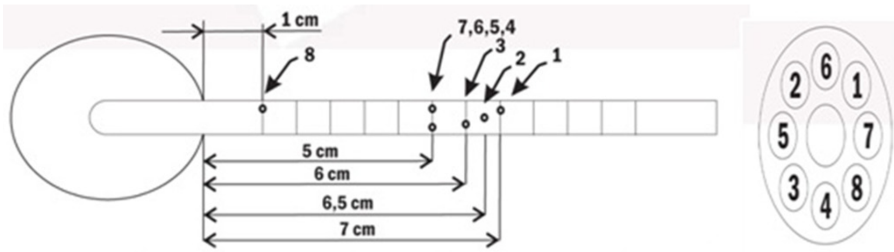

Figure 3. Anorectal manometry catheter which was used in the study.

Table 2. The comparison of Abdominal and Anal pressure levels at pre-operative and postoperative of experimental group

		n	$\bar{X}$ ± Sd	Median	Z[a]	p[b]
Abdominal Pressure	Pre-operative	53	-2.585 ± 5.353	-1.925	-5.358a	0.000***
	Post-operative	53	2.332 ± 3.618	2.175		
Anal Canal Pressure	Pre-operative	53	32.343 ± 13.81	33.775	-6.334a	0.000***
	Post-operative	53	45.39 ± 12.902	46.963		

[a]Based on positive ranks-Wilcoxon Signed Rank Test; ***p < 0.001; [b]Monte Carlo Sig.(2-tailed) Based on 10000 sampled table.

Table 3A. The comparison of abdominal pressure level of experimental group at Post-Operative in accordance with pain, paresthesia, anal diseases and hernia type

		n	$\bar{X}$ ± Sd	Mean Rank	U[a]	p[b]
Pain	Unavailable	40	2.407 ± 3.465	27.11	255.500	0.934
	Available	13	2.102 ± 4.198	26.65		
Paresthesia	Unavailable	32	2.237 ± 3.784	26.61	323.500	0.825
	Available	21	2.477 ± 3.437	27.6		
Anal Diseases	Unavailable	48	2.324 ± 3.668	26.71	106.000	0.685
	Available	5	2.405 ± 3.478	29.8		
					Chi Square[c]	p[b]
Hernia Type	Right	30	2.438 ± 4.010	28.38	2.723	0.258
	Left	18	2.682 ± 3.243	27.69		
	Bilateral	5	0.440 ± 1.957	16.2		

[a]Mann Whitney U Test; [b]Monte Carlo Sig.(2-tailed) Based on 10000 sampled table; [c]Kruskal-Wallis Test.

14.257 years. There was no difference between the groups in terms of age (U = 1274.00, p = 0.74). The mean BMI in G1 was 23.655 ± 0.765 preoperatively and 23.684 ± 0.756 six months postoperatively. There was no significant difference between these values (Wilcoxon signed rank test, Z = -0.249, p = 0.80). The mean BMI in G2 was 23.3 ± 1.182. There was no significant difference between the baseline BMIs of G1 and G2 (U = 1178.00, p = 0.33). Similarly, there was no significant difference between postoperative BMIs in G1 and baseline BMIs in G2 (U = 1131.00, p = 0.20). Differences in intra-abdominal pressures (IAPs) and anal pressures between G1 and G2 were investigated separately. There was a significant difference between IAPs taken preoperatively and postoperatively (p < 0.001). Preoperative IAP increased from -2.585 ± 5.353 mmHg to 2.332 ± 3.618 mmHg after the operation. There was also a significant difference in anal canal pressures taken preoperatively and postoperatively (p < 0.001). The mean anal pressure increased from 32.343 ± 13.1 mmHg to 45.39 ± 12.902 mmHg after the operation (**Table 2**).

There was no relationship between postoperative IAP and postoperative pain, paresthesia, concomitant anal diseases, or type of hernia (p > 0.05) (**Table 3A**).

Similarly, there was no relationship between postoperative anal pressures and postoperative pain, paresthesia, concomitant anal diseases, and type of hernia (p > 0.05) (**Table 3B**).

A statistically significant difference between was found between G1 preoperative measures and G2 in terms of both intraabdominal and anal pressures (p < .001). In both cases the pressure in G1 was lower than in G2 (**Table 4**).

Discussion

Lichtenstein hernioplasty is a tension-free technique that utilizes polypropylene mesh as mechanical barrier [12]. Low recurrence rates

Table 3B. The comparison anal canal pressure level of experimental group at postoperative in accordance with pain, paresthesia, anal diseases and hernia type

		n	X̄ ± Sd	Mean Rank	U[a]	p[b]
Pain	Unavailable	40	45.541 ± 13.055	27.2	252.000	0.879
	Available	13	44.924 ± 12.926	26.38		
Paresthesia	Unavailable	32	45.029 ± 14.029	26.47	319.000	0.769
	Available	21	45.940 ± 11.278	27.81		
Anal Diseases	Unavailable	48	45.679 ± 12.758	27.48	97.000	0.499
	Available	5	42.610 ± 15.515	22.4		
					Chi Square[c]	p[b]
Hernia Type	Right	30	47.228 ± 13.049	29.33	1.627	0.449
	Left	18	43.363 ± 13.105	24.33		
	Bilateral	5	41.658 ± 11.760	22.6		

[a]Mann Whitney U Test; [b]Monte Carlo Sig.(2-tailed) Based on 10000 sampled table; [c]Kruskal-Wallis Test.

Table 4. The comparison of Abdominal-Anal Canal pressure values of experimental group at pre-operative with those of control group

	Group	n	X̄ ± Sd	Mean Rank	U[a]	p[b]
Abdominal Pressure	G1	53	-2.585 ± 5.353	38.76	623.500	0.000***
	G2	50	1.159 ± 1.956	66.03		
Anal Pressure	G1	53	32.343 ± 13.810	35.23	436.000	0.000***
	G2	50	51.886 ± 14.151	69.78		

[a]Mann Whitney U Test; [b]Monte Carlo Sig.(2-tailed) Based on 10000 sampled table; ***$p < 0.001$.

and shorter learning curves made the Lichtenstein procedure the principal operation for hernia repair worldwide [13]. Investigations of hernia repairs once focused on recurrence, complications, and costs; however, as Lichtenstein hernioplasty has become the primary surgical procedure, attention now centers on other outcomes such as postoperative acute or chronic pain [14]. It is hard to say at exactly what point postoperative pain becomes chronic pain. Postoperative pain is generally accepted as chronic pain if it persists longer than the usual convalescence period. This is suggested to be three to six months [15].

Intra-abdominal pressure is defined as the steady-state pressure in the abdominal cavity, and it varies with body weight, position, and abdominal muscle tone [16, 17]. Temporal raises in IAP, such as those associated with pneumoperitoneum in laparoscopic surgery, are less likely to cause persistent side effects. Some clinical conditions such as ascites, tumors, eschars on the abdominal wall, edema or distention of bowels, intra-abdominal blood or fluid accumulation [18], or forced closure of a swollen abdomen or defective abdominal wall [19] may lead to a permanent increase in IAP [20, 21].

Our purpose was to investigate how inguinal hernia influences resting anal and abdominal pressures. The results, which compared abdominal and anal pressures taken before and after inguinal hernia operation and from the control group, revealed significant differences in pressures. Previous studies generally utilized intravesical pressure in order to measure IAP [22-24]. Shafik *et al*. compared indirect measurement of IAP through a rectal balloon with direct measurement through a Veress needle while patients were at rest, straining, supine, and erect. They found that rectal measurement of IAP was concordant with direct intra-abdominal measurements and concluded that the rectal balloon was a reliable way to measure IAP [25].

We measured intra-abdominal pressure manometrically using an 8-channel, 4 mm diameter catheter placed in the sigmoid colon, intraluminally. Interpretations of our measurements presented significant results. Average [SD] IAP was -2.58 mmHg [5.35] among unoperated hernia patients, whereas it was 1.16 mmHg [1.96] for the control group. It was 2.33 mmHg [3.62] after hernia repair. Abdominal pressures were negative in the patients with hernia; it was found to be at the physiological limit after hernia repair. Even though IAPs were found to be at the physiological limit after operation, they were higher than those in the control group. Moreover, when abdominal and anal resting pressures were evaluated together, we found significant parallelism. While IAPs after hernia repair were higher than they were preoperatively, the frequency of local symptoms on surgical fields was not statistically significant, in the postoperative period. Seroma was observed on surgical fields postoperatively in 11 patients and pain on the surgical field was reported in 13 of them. Postoperative morbidity was inadequate for statistical analysis. These local postoperative findings do not seem to be associated with changes in manometric measurements.

Consequently, Lichtenstein tension-free hernioplasty causes an increase in anal and abdominal pressures, but this increase does not reach pathological levels. Anal resting pressures after hernia repair, as mentioned before, were lower than in the control group. Two years postoperatively, only 3 patients developed proctologic diseases; 2 of them suffered from internal hemorrhoids and 1 suffered anal fissure. All 3 patients were treated medically.

The abdominal wall is a dynamic structure which plays a complex role in maintaining intra-abdominal and anal pressures. Inguinal hernia is a mechanical disorder which disrupts the regular function of the anterior abdominal wall. Mesh hernioplasty may lead to complex changes in the abdominal wall's architecture through local tissue reactions [7, 8]. These changes seem to improve the function of the anterior abdominal wall which may result in an increase in intra-abdominal and anal pressures that approach physiological levels. Furthermore, postoperative pain and seroma complaints were not associated with the increase in pressure levels.

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Disclosure of conflict of interest

All named authors hereby declare that they have no conflicts of interest to disclose.

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