Hernia
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ORIGINAL ARTICLE

Unilateral Lichtenstein tension-free mesh hernia repair and testicular perfusion: a prospective control study

J. Aguilar-García[1] · H. A. Cano-González[1] · M. A. Martínez-Jiménez[1,2] · F. de la Rosa-Zapata[2] · M. Sánchez-Aguilar[3]

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Abstract

Purpose Compare testicular perfusion between the herniated and the healthy side pre- and post-surgery.

Materials and methods Our study was done on patients with unilateral inguinal hernia. A Doppler ultrasound study was performed in the healthy and herniated side before surgery and 3 months after it.

Results 31 patients were included, 74.2% on the right and 25.8% on the left side. When comparing the pre-surgical values of testicular resistance index from the healthy side with those on the herniated side, there was a significant difference at the spermatic cord levels (0.73 ± 0.11 and 0.81 ± 0.13, $p = 0.018$) and the extra-testicular level (0.66 ± 0.92 and 0.74 ± 0.10, $p = 0.032$), but a significant difference was not present at the intra-testicular level (0.62 ± 0.07 and 0.65 ± 0.08). Three months after the surgery, there were no statistically significant differences at any of the levels studied.

Conclusion There are no intra-testicular perfusion differences caused by the presence of hernia, nor during post-surgery.

Keywords Testicular perfusion · Inguinal hernia · Color Doppler ultrasound · Polypropylene mesh · Lichtenstein technique

Introduction

Inguinal hernia are ten times more common in men than in women, testicular complication affecting sexual function, but there is no clear explanation on the cause of infertility in patients who have had an inguinal hernia [1–9]; the inflammatory response of the tissue due to the placement of the mesh might cause a functional obstruction of the spermatic cord, thus diminishing the spermatozoid flux and decreasing perfusion through time [10].

The original technique for fixation of mesh in Lichtenstein hernioplasty used non-absorbable sutures whichis the standard open tension-free repair of inguinal hernia. Polypropylene mesh induces a foreign-body reaction. Both the technique and the mesh material have an impact on integrity of spermatic cord and testicular function; the reason for testicular damage may be due to ischaemic orchitis or immunological reactions [11–13].

We test with Doppler ultrasound if there is diminished testicular perfusion caused by the hernia and if surgery corrects this decrease. A decreased testicular perfusion might participate in the presence of secondary infertility and surgery might correct it [14].

Several studies have demonstrated the repair of inguinal hernia not alter testicular flow dynamics in early or late postoperative period [15–19]. The aim of this study is to compare testicular perfusion between the herniated and the healthy testicles pre- and post-surgery.

Materials and methods

A prospective, observational study was done which included patients aged 18–65 years old with unilateral inguinal, who attended the general surgery service of the Hospital Central Dr. Ignacio Morones Prieto, in San Luis Potosí, México. Physical examination confirms the presence of inguinal hernia. Patients diagnosed with hydrocele, varicocele, testicular tumor and bilateral hernia were excluded. The inguinal hernia repair was performed using the Lichtenstein technique,

✉ M. Sánchez-Aguilar
jemarsan7@hotmail.com

[1] General Surgery Department, Hospital Central Dr. Ignacio Morones Prieto, San Luis Potosí, Mexico

[2] Radiology Department, Hospital Central Dr. Ignacio Morones Prieto, San Luis Potosí, Mexico

[3] Department of Epidemiology and Public Health, Universidad Autónoma de San Luis Potosí, Mexico. Av. Venustiano Carranza 2405, Los Filtros, 78210 San Luis Potosí, Mexico

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with polypropylene monofilament prosthetic mesh of appropriate size used in each case (Prolene Mesh, Ethicon Inc., Johnson & Johnson Ltd, weight 44 g/m^2), using standard technique by experienced surgeon. Patients with complications such as wound seroma or hematoma and wound infection were excluded. This study was approved by the hospital´s ethics committee (Reg 113-14), and all patients provided informed consent.

A Doppler ultrasound study was performed measuring the healthy and herniated side before surgery and 3 months after it [15], measuring the testicular resistance index at the levels of the spermatic cord and at the extra-testicular (1 cm extra-capsular) and intra-testicular levels. The hernia volume was also calculated.

Statistical analysis

The data were analyzed using the statistics package JMP version 8 (SAS Institute Inc., Cary, NC, USA). Results are expressed as mean ± SD. Interobserver correlation analysis was done using the Pearson coefficient. Analysis of variance ANOVA was employed. Data were considered as statistically significant when $p < 0.05$.

Results

Interobserver correlation was determined by two observers with ultrasound study in 20 sides with healthy volunteers. In this control, in subjects at the level of the spermatic cord the value was of 0.87 ± 0.10; at the extra-testicular level, it was of 0.75 ± 0.12, and at the intra-testicular level it was of 0.65 ± 0.15. On the healthy side, good correlation was found at the level of the spermatic cord. The intraclass correlation coefficient of ultrasound study was $r^2 = 0.92$ (95% CI, 0.929–1) ($p < 0.001$).

31 patients were included and the mean age of the patients was 45.87 ± 16.44 years; 74.2% of them were on the right and 25.8% on the left side. In 13 patients out of 31, there was a non-reducible hernia and the measured hernia volume sac was of 14.1 cc (Table 1).

When comparing the pre-surgical values of testicular resistance index from the healthy side with those on the herniated side, there was a significant difference at the spermatic cord levels (0.73 ± 0.11 and 0.81 ± 0.13, $p = 0.018$) and the extra-testicular level (0.66 ± 0.92 and 0.74 ± 0.10, $p = 0.032$), but a significant difference was not present at the intra-testicular level (0.62 ± 0.07 and 0.65 ± 0.08). The comparative analysis of the values from the healthy and herniated testicles showed a significant difference of 3 months after the surgery at the spermatic cord level ($p = 0.016$) and the extra-testicular level ($p = 0.0008$). Once again, there was no significant difference at the intra-testicular level (Table 2).

Table 1 Demographic information

Variable	Values
Age (years)	45.87 ± 16.44
BMI (kg/m^2)	23.19 ± 2.06
Evolution time (years)	2.69 (0.16–25)
Hernia type	
Volume (cc)	14.1 (8–147)
Location (Right/left)	74.2%/25.85%
Nyhus (1/2/3a/3b)	10/18/2/1

In the healthy side, good correlations were found at the level of the spermatic cord $r^2 = 0.926$ (95% CI, 0.916–1) ($p < 0.0001$), at the extra-testicular level $r^2 = 0.804$ (95% CI, 0.8–1) ($p < 0.0001$), and at the intra-testicular level $r^2 = 0.837$ (95% CI, 0.802–1) ($p < 0001$). Good correlations were also found in the herniated side values of TIR before and after the surgery at the spermatic cord level $r^2 = 0.955$ (95% CI, 0.915–1) ($p < 0.0001$), at the extra-testicular level $r^2 = 0.864$ (95% CI, 0.845–1) ($p < 0.0001$), and at the intra-testicular level $r^2 = 0.695$ (95% CI, 0.676–1) ($p < 0.0001$).

In this study, we also tried to find a correlation of testicular resistance index with the time of evolution of the hernia and with BMI that had not been sought, without finding a positive result.

Discussion

The information regarding the complications associated with inguinal hernia repair related to testicular perfusion is controversial since most reported studies are experimental and results from clinical studies differ in their results. Turgut et al. [14] investigated whether the inguinal hernia impacted upon blood volume and flow through scrotal ultrasonography. In this study, 26 males with unilateral inguinal hernia had a higher testicular volume on the side of the inguinal hernia when compared to that of healthy contra lateral testicles (15.46 ± 4.49 against 14.54 ± 3.65 mL, $p < 0.05$). Furthermore, the rate of average resistance in the intra-testicular artery was significantly higher on the side of the hernia when compared to the contra-lateral side (0.66 ± 0.06 against 0.63 ± 0.05, $p < 0.05$) [11]. Our data on testicular resistance index agree with their results since the values found in this study were significantly higher; nevertheless, in contrast to the study by Turgut et al., the values that were elevated in this study were the extra-testicular ones [14].

In 2008, Pinggera et al. [20] investigated the usefulness of measuring the intra-testicular resistance index by Doppler ultrasound to establish diagnostic criteria for normal and

Table 2 Result of statistical analysis

	Pre-surgery			Post-surgery		
	Healthy side	Herniated side	*p*	Healthy side	Herniated side	*p*
Cord	0.738 ± 0.112	0.816 ± 0.139	0.018	0.739 ± 0.111	0.818 ± 0.124	0.016
Extra-testicular	0.667 ± 0.92	0.744 ± 0.103	0.032	0.669 ± 0.077	0.749 ± 0.089	0.0008
Intra-testicular	0.628 ± 0.078	0.65 ± 0.084	0.30	00.628 ± 0.067	0.652 ± 0.082	0.24

*Data are presented as mean ± SD

p values obtained by ANOVA

pathological spermatozoid counts. This was a prospective study done on 160 patients; 80 had normal spermatozoid counts and 80 had pathological counts. The resistance index was significantly higher in patients having abnormal counts (0.68) than in subjects with normal counts (0.54) $p < 0.001$. In our study population, we found that in the healthy side the average testicular resistance index was 0.6287 ± 0.078, and in the herniated side 0.6525 ± 0.082.

When we compared the pre- and post-surgery values, there was a significant difference at the spermatic cord level ($p = 0.018$) and at the extra-testicular level ($p = 0.032$), but not at the intra-testicular level where the difference was not statistically significant. These findings also differ with a previous report published by Stula et al. [21] in 2012. These authors made a prospective study to determine if changes in the circulation and immunologic disease in the testicles after repairing an inguinal hernia with a mesh were related to infertility problems. 43 patients with an average age of 62 years (range 33–81 years) were initially recruited. The mean duration of the symptoms was of 16 months (range, 2–108 months). Of all the patients, 15 were subjected to laparoscopic reparation of the hernia (TAPP) constituting Group I, and the rest of the patients (28 patients) underwent an open reparation without tension (Lichtenstein technique) constituting Group II. During the color Doppler echocardiographic evaluation, the blood flow was measured in patients before the surgery, in 42 patients 2 days after the surgery and in 37 patients 5 months after the procedure. In the statistical analysis, only patients having undergone the three measurements were included. There were no significant differences between the groups in the Doppler determined flow parameters for the pre- and early and late post-surgery measurements. However, there were significant differences in testicular resistance index from intra-testicular measurements in group I ($p = 0{,}005$) with a significant increase between the pre-surgery and the second post-surgery measurement that returned to the basal level in the late post-surgery period. The results from this study differ from what was found in the present report since all of our patients underwent anterior open reparation with Lichtenstein technique and in our study the elevated values in the pre-surgery determination were those at the extra-testicular level. Another difference between these studies and ours is that in our measurement, there was decrease of the elevated levels in the herniated side 3 months after the surgery performed [22].

Thus, we can infer that although the testicular resistance index values are elevated, there is no clinical relation to infertility; however, in our study only patients having a unilateral hernia were included. In 2011, Hallen et al. [23] made a prospective study to determine infertility after bilateral inguinal hernia repair. Patients were asked to answer a questionnaire on the involuntary lack of children, if they had been previously studied for infertility problems and the number of descendants before and after inguinal hernia repair. Group 1 of this study included 192 subjects aged 18–55 years who were operated without a mesh; group II included 384 patients operated with a mesh and group III, 384 health subjects. The three groups were compared. The results from this study do not favor the hypothesis that the reparation of the bilateral inguinal hernia with a mesh prosthesis causes male infertility in a higher proportion than the reparation without a mesh. However, this study was only based upon a questionnaire. In 2005, Shin et al. [24] reported the multi-institutional experience in men with secondary infertility after the reparation of the inguinal hernia using a propylene mesh. They found that in eight institutions in the United States, there were a total of 14 cases of secondary azoospermia due to the obstruction of the deferent spermatic conducts, related to the inguinal hernia repair using a propylene mesh. The mean average age of the patients included in this study was of 35.5 years, with a mean duration of infertility of 1.8 years. The number of years between the urologic evaluation and the hernioplasty was of 6.3 years. The type of reparation employed had been: open (10), laparoscopic (2), or both (2). Nine patients showed bilateral obstruction and five unilateral obstruction with contralateral testicular atrophy or with obstruction of the epididymis. The surgical exploration revealed a fibroblast response surrounding the propylene mesh that integrated the vas deferens in all patients.

We found that when the pre- and post-surgery measurements were taken in the affected side, there were no differences in the values, and a long-term measurement could let us know if values improved or worsened.

Conclusion

There are no intra-testicular perfusion differences caused by the presence of hernia, nor during post-surgery.

Compliance with ethical standards

Conflict of interest JAG, HACG and MAMJ and declares no conflict of interest, MSA declares conflict of interest directly related to the submitted work, FDRZ declares conflict of interest not directly related to the submitted work.

Ethical approval This study was approved by the hospital´s ethics committee (Reg 113-14). All procedures performed in studies involving human participant were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Human and animal rights This article does not contain any studies with animals performed by any of the authors.

Informed consent All patients provided informed consent.

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