

Research Article

Different Methods of Hernia Repair and Their Influence on the Reproductive Health in Men

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ABSTRACT

The aim of the study was to evaluate the influence of different methods of hernia repair on male reproductive function. The study gives scientific grounds to the choice of the method of reproductive health sparing hernia repair, the evaluation of the structural changes after different methods of hernia repair, and the comparative characteristics of the clinical development of the post-operative period in patients.

Materials and Methods. The study included 156 patients who had hernia repair performed. The operated patients were divided into three groups. The main group included 52 patients that had Desarda hernia repair performed, 52 patients had Shouldice hernia performed, and 52 patients had Lichtenstein hernia repair performed. All the patients before the operation and 20 days after the operation underwent ultrasound scanning of both inguino-scrotal regions. During all the post-operative period, all the patients had the intensity of pain syndrome evaluated. It was a double-blind, randomized clinical study conducted in four surgical departments in Makhachkala and Derbent cities from September 2014 to July 2017. The study included male patients aged from 18 to 48 with a primary inguinal hernia. The experimental treatment in this study was Desarda surgery, which was compared with the Shouldice and Lichtenstein surgeries. The patients were randomized in the blocks and stratified by the centers.

Results. Ultrasonography scanning showed that the patients with an inguinal hernia had disorders in hemodynamics in testicle parenchyma. It was noted that the maximum systolic and diastolic blood pressure. In the post-operative period, all the patients with indirect and direct inguinal hernia had the rate of intratesticular circulation increased. The patients, who underwent Desarda hernia repair, had these parameters values significantly higher than in patients who underwent Lichtenstein hernia repair. It should be noted that patients from the control group had a significantly increased index of resistance, which indicates the compression of the elements of the spermatic cord. Desarda hernia repair improves the intertesticular hemodynamics in patients. Totally, 156 patients were randomized. There were no significant differences observed between the groups. Four patients from the Desarda hernia repair group had a relapse within 5 years after the surgery, and only in two patients from the Lichtenstein hernia repair group and in three patients from the Shouldice hernia repair group. Early operative complications in patients who had Desarda surgery was observed in 7.8%, in patients who had Lichtenstein surgery - in 18.4% and Shouldice surgery – in 13.4%.

Key words: inguinal hernia, hernia repair, Desarda surgery, reproduction

INTRODUCTION

Acute ischemia of testicle in patients who had hernia repair develops rarely and is associated with the wound bandaging, resection of spermatic cord and thrombosis of testicular artery. Arterial circulation disorders after hernioplasty of the inguinal canal include chronic ischemic events and ischemic orchitis

(in 3.5% of cases) [1,10]. Chronic ischemia of a testicle after the hernia repair develops as a result of the compression of arteries that feed the genital gland in the post-operative infiltrate and tight sutures that get involved into the forming scar and compress the spermatic cord [5,7]. The developing ischemia of testicles is accompanied

by necrobiotic alterations of the seminiferous epithelium which leads to the spermatogenesis failure and decrease of hormone production. The negative influence of hernia repair on the reproductive function in men is generally acknowledged and it is often evaluated by clinical studies [2,9]. The most important pathogenetic factor of reproductive disorders in patients with inguinal hernia is the mechanical damage of anatomic structures of the inguinal canal on the side of the hernia location [10,18]. Unilateral ischemia leads to the changes in arterial inflow and the increase in the vascular tonus of the opposite testicle. It is explained by the reflectory and trans scrotal changes in the vascular tonus of the organ arteries of testicles that received the crossed sympathetic innervation [6,7]. The highest risk of the development of testicle blood circulation disorders includes such stages of hernia dissection as narrowing of the deep inguinal ring around the spermatic cord, mobilization, and dissection of the later, separation of the hernia sac and narrowing of the external opening of the inguinal canal. During the past years, in the majority of clinics, the surgeons prefer to perform hernioplasty with synthetic materials. A number of the open wound and endoscopic methods were developed for the implantation of endografts. The basic method of the repair is the Lichtenstein technique that is based on the polypropylene mesh net grafting of the back wall of the inguinal canal. The quality of life of the patients, that had the specified surgery performed, did not differ significantly from the quality of life of patients who underwent the hernia repair by other modern methods such as transabdominal preperitoneal (TAPP) and total preperitoneal (TEP) endoscopy. Nevertheless, the Lichtenstein technique has some drawbacks. Experimental and clinical trials showed that the later could be associated with the excessive formation of the connective tissue in the area of the implanted graft, deformation and obstruction of the seminal ducts [8,15]. The majority of the alternative methods (TAPP, TEP, Nyhus) have the same peculiarities. During these surgeries for the repair of the inguinal canal, the ductus deferens also adjoins the significant area of the

graft. This does not exclude the further development of male infertility, but the later can be associated with other factors as well. Another cause of blood circulation disorders in the system of the genital gland is the failure of blood and lymph outflow from the testicle which is associated with the edema of the scrotum and its organs. There is a direct correlation and dependence between the expression of stasis and the degree of the atrophic alterations. The dissection of m.cremaster during the separation of the spermatic cord leads to the loss of the cremasteric reflex. M.cremaster function failure has a negative trophic impact on the genital gland, leads to the stasis of venous blood and lymph in the system of the spermatic cord, further blood and lymph circulation disorder and testicle innervation failure. During the past years, many authors have highlighted the necessity in further improvement of the conventional methods and the development of the traditional and new approaches to the surgical treatment for inguinal hernia for quick social and professional rehabilitation of patients [4,17]. Modern approaches to surgical treatment for inguinal hernia are based on the grafting of the back wall of the inguinal duct, which can be performed by both mesh (Bassini, Shouldice, Postempsky) and no mesh (Trabucco, Lichtenstein, Desarda) approaches, which provide good long-term treatment results and minimum probability of a relapse. It is known that a persisting hernia in reproductive age males leads to the spermatogenesis disorders [1,11]. The influence of an inguinal hernia on the genital gland functioning is associated with the compression of spermatic cord vessels by the content of the hernial sac. In this case, several pathological mechanisms develop simultaneously.

On the one hand, the compression of arteries that feed the genital gland lead to chronic ischemia of a testicle with its further atrophy and function failure [2,19]. The seminiferous epithelium is highly sensitive hypoxia. Circulatory insufficiency leads to the alterations in the terminal vasculature with acute reduction of vascular permeability and destruction of spermatogenous cells [2,20].

On the other hand, the reduction of venous circulation causes venous stasis in the pampiniform plexus, which contributes to the development of the associated hydrocele. The accumulation of the fluid between the membranes prevents the microcirculation in the testicle tissues and provokes the intratubular atrophy of the convoluted seminiferous tubules, which leads to the decrease of spermatogenesis [12].

Apart from this, the stasis in the testicle veins leads to the testicle thermoregulation disorders [1]. It is known that the increase in a testicle temperature negatively influences its generative function: germ cells degenerate causing the spermatogenesis disorders. It should be mentioned that patients with inguino-scrotal hernias, the changes in testicle temperature are engraved by the closely located hernia sac, which temperature is the same as in the abdominal cavity.

It was noted that the most expressed changes in reproductive function were observed in patients with indirect inguinal hernia, when the hernia sac with its content was located close to the vessels, spermatic cord and ductus deferens and had a significant impact on the specified structures [3,7].

Direct hernia influences on the adjoining structures primarily if it is located in a major size hernia sac [5, 6, 8]. Lately, more and more attention is paid to the role of surgical treatment of the reproductive function [2, 7]. Around 7.2% of men with obstructive azoospermia have iatrogenic damage of ductus deferens in the anamnesis. In 88% of men, it is caused by surgical treatment for an inguinal hernia [15,17]. According to the study [1], among men with generative function disorders and hernia repair in childhood, the obstruction of ductus deferens is observed in 26.7%. It should be noted that iatrogenic damage of the ductus deferens is observed only in 0.04% of cases, which can indicate the influence of the cicatricial process that develops after the surgery [1,10].

Other testicular complications are observed significantly rarer. Thus, hydrocele develops in 0.4-1.6% of patients after the Lichtenstein surgery and Postempsky surgery, ductus

deferens vein damage – in 0.7-0.9% of patients, orchitis – in less than 0.7% of patients [1]. Acute ischemic orchitis is a rare complication that develops within 2-3 days and is associated with the testicular veins thrombosis or iatrogenic damage of arteries. In severe cases, it can lead to the infarction of a testicle.

The study of the long-term effect of the inguinal hernia repair in men aged 18 – 37 years old, whose spouses could not conceive for two and more years, showed that there changes in the spermogram parameters in 76.8% [6,15]. The sperm count and their activity decreased. In 13% of patients, there was a bilateral hernia in the anamnesis, in the rest cases – unilateral. 70% of men were operated at the age of 9 years old, in 12% of them, hydrocele was observed in the early post-operative period, in 33.7% of them – ejaculation failure [1].

According to the study [3], in 25% of cases, traditional hernia repair leads to the disorders in microcirculation of testicular and scrotum tissues with partial atrophy of a testicle, circulation rate in testicles reduces by 2.2-2.5 times, the main parameters of spermogram and testosterone levels in serum often decrease, and in the majority of cases, the cremasteric reflex suffers [7].

For the evaluation of the reproductive function in the post-operative period, several main parameters are used. A clinical study for the evaluation of cremasteric reflex, that reflects the integrity of the muscle lifting the testicle, was performed. To exclude the atrophy of a testicle, orchidometry was conducted by means of ultrasonic scanning. An indirect symptom of testicle atrophy is the decrease of testosterone level in blood [5,7,19]. The evaluation of the circulation rate in the testicle artery and vein by Doppler scanning reveals the damage of vessels and allows the specialists to identify the degree of the gland circulation failure. And finally, spermatogenesis disorders are revealed by the evaluation of the patient spermogram.

Thus, it can be stated that the surgery method of choice for an inguinal hernia is no mesh hernioplasty of the back wall of the inguinal duct, which can be performed by both open access and laparoscopic approach. Presently,

the issue of the choice of a hernioplasty method for the treatment of an inguinal hernia remains acute in men of the reproductive age. The solution for this issue is a primary task because, presently, around 15% of couples face the problem of infertility, which is associated (fully or partly) with the male factor [2]. Since there is a great incidence rate of an inguinal hernia among men of the reproductive age, it is necessary to perform a comparative analysis of the influence of different methods of hernia repair on the germinative function in order to identify the safest methods [2].

The aim of the present study was to evaluate the influence of different methods of a hernia repair surgery on male reproductive function. The study gives scientific grounds to the choice of the method of reproductive health sparing hernia repair, the evaluation of the structural changes after different methods of hernia repair, and the comparative characteristics of the clinical development of the post-operative period in patients.

MATERIALS AND METHODS.

A double-blind, randomized clinical study was performed in four surgical departments in Makhachkala and Derbent cities from September 2014 to July 2017. The study included 156 patients with inguinal hernias: indirect inguinal hernia (type II by the Nyhus classification) – 68, direct inguinal hernia (type III A) – 64, and combined inguinal hernia (type III B) – 24. Right-sided localization of hernia was observed in 98 patients, left-sided – in 50 patients, and bilateral – in 8 patients. The surgery was performed under endotracheal (18), intravenous (40), spinal anesthesia (45) and local anesthesia (53). The patients' age ranged from 18 to 48 years old. All the patients underwent clinical examination and laboratory testing. The patients had the system of hemostasis evaluated. Before the surgery, all the patients were examined by other medical specialists as well. To evaluate the influence of different methods of hernioplasty, three groups of patients were formed containing 18 patients each. The patients from group I had Shouldice surgery performed, from group II – Lichtenstein

hernioplasty, and from group III – Desarda hernia dissection surgery. The patients in the groups of comparison were similar by age, weight, localization, and size of hernial defects. All the surgeries were performed as planned and under spinal anesthesia. All the hospitalized patients were chosen by the following criteria. The study entry criteria included:

- Diagnosed inguinal hernia by Nyhus classification;
- Planned surgical treatment for the inguinal hernia;
- Patients aged from 18 to 48 years old.

These criteria were met by 156 patients hospitalized during the specified period.

The study withdrawal criteria were:

- Relative and absolute contraindications to any type of hernioplasty that were studied;
- Surgery for varicocele or hydrocele in the anamnesis;
- Spermatogenesis disorders in the anamnesis revealed before the hernia development;
- Cryptorchism;
- Refusal to participate at any stage of the study (withdrawal of the signed informed consent for the participation in the scientific study).

The patients' questionnaire showed that 69 patients (44.2%) were married. A decrease of libido and problems with the erection were observed in 34 patients (25%). In all the cases in group II, polypropylene mesh was used. Colored duplex scanning of the spermatic cord vessels was performed by the ultrasonic scanner ALOKASSO-1770 before the surgery and 20 days after the surgery. The specialists evaluated the arterial circulation rate parameters; circulation peak rate (CPR) circulation mean rate (CMR), circulation linear rate (CLR), index of the resistance (Ri) and venous circulation rate parameters. Morphological study of the sperms was performed by the criteria of Kriser-Menkveld [5]. The patients were included into the study following all the basic principles of biomedical ethics for the clinical studies. The protocol of the study was approved by the local ethical committee of Dagestan State Medical University. The statistical analysis was

conducted by the software package “Statistica 6.0 for Windows” (StatSoft Inc., USA). The character of the sample distribution was identified by the Shapiro-Wilk test. The results were presented as $M \pm m$, where M – mean value, m – error of the mean. The comparison of the quantitative parameters in unpaired groups was performed by the Mann-Whitney U-test. The analysis in the paired groups (if the number of samples was sufficient) was conducted by the Wilcoxon test. The correlation between the studied parameters was analyzed by the Spearman's rank correlation

coefficient (R). The difference was considered statistically significant at $p < 0.05$.

RESULTS.

Laboratory tests of the ejaculate before the surgery and after the surgery are important for the evaluation of the influence of different surgical approaches to hernioplasty on the male fertility. The quality of ejaculate was characterized by the sperm count in a unit of ejaculate and the ratio of active to inactive sperms in the examined patients (Table 1).

Table 1. Spermogram results in patients with inguinal hernia before the surgery.

Parameter	Shouldice hernia repair, group I, n= 36	Lichtenstein hernia repair, group II, n= 37	Desarda hernia repair, group III, n = 37
Ejaculate volume (ml)	3.1±0.17	3.1±0.18 p*=0.50	3.1±0.79 p*=0.4;p**=0.56
Sperm count (mln in 1 ml)	87.6±8.17	90.7±9.10 p*=0.18	50.1±7.18 p*=0.78; p**=0.60
Active sperms (in %)	75.9±6.99	76.6±1.97 p*=0.049	77.9±3.78 p*=0.07; p**=0.75

*- significant in comparison with group I; **- significant in comparison with group II.

The parameters of fertility (Table 1) agreed with the reference values that were decreased in all the groups (no significant difference between the groups was observed). At the same time, significant variability was observed in patients with an indirect inguinal, recurring, and inguino-scrotal hernias. These data prove the statements of other authors [14,15], that highlighted the negative influence of hernia on the spermatogenesis in patients in the post-operative period after a hernioplasty performed by different methods. The dynamics of the spermogram parameters was negative. Three months after the hernioplasty, although the volume of ejaculate insignificantly increased (0.5 ± 1.04 ml $p=0.00$), there was a significant decrease in the sperms count by 18.1 ± 19.9 mln/ml ($p=0.00$) and the reduction of sperm activity by $6.9 \pm 4.18\%$ ($p=0.00$).

Table 2. Spermogram results in patients after Shouldice hernia repair.

Parameter	$M \pm \sigma$	N=36	$\Delta \pm \Delta$	t	d□	p*
Ejaculate volume (ml), initial	2.99±0.74					
Ejaculate volume (ml), 3 months after the surgery	3.4±0.69	36	-0.6±1.17	-3.18	17	0.003
Ejaculate volume (ml), 1 year after the surgery	3.5±0.77	36	-0.6±1.18	-3.01	17	0.0051
Active sperms (%), initially	66.8±6.97					
Active sperms (%), in 3 months after the surgery	69.7±4.18	36	13.6±9.8	8.27	17	0.00
Active sperms (%), 1 year after the surgery	70.8±6.17	36	14.5±8.45	6.02	17	0.00

*- in comparison with the initial values

After the conventional Shouldice hernioplasty, the negative changes in the spermogram parameters persisted. Although there was some tendency to the improvement after the surgery, the parameters did not normalize (Table 3). The dynamics of the spermogram parameters in patients after Lichtenstein hernioplasty was lower than after the conventional hernioplasty.

Table 3. Spermogram results in patients after Lichtenstein hernia repair.

Parameter	M±σ	N=36	Δ± Δ	t	d□	p*
Ejaculate volume (ml), initial	3.1±0.62					
Ejaculate volume (ml), 4 months after the surgery	3.2±0.65	36	-0.4+0.94	-3.5	17	0.0007
Ejaculate volume (ml), 12 months after the surgery	3.1±0.77	36	-0.2+0.93	-2.2	17	0.036
Active sperms (%), initially	68.6±3.19					
Active sperms (%), in 4 months after the surgery	59.8±3.10	36	-6.7+3.91	15.8	17	0.00
Active sperms (%), 12 months after the surgery	63.9±3.11	36	4.9+3.10	15.8	17	0.00

*- in comparison with the initial values

The most promising results were observed in patients in the post-operative period after the Desarda surgery (Table 4).

Table 4. Spermogram results in patients after the Desarda hernia repair.

Parameter	M±σ	n-37	Δ± Δ	t	d□	p*
Ejaculate volume (ml), initial	3,2±0,86					
Ejaculate volume (ml), 4 months after the surgery	3,4±0,51	37	-0,2+1,03	-0,89	17	0,39
Ejaculate volume (ml), 12 months after the surgery	3,3±0,45	37	-0,2+1.26	-0,5	17	0,64
Active sperms (%), initially	77,9±3,91					
Active sperms (%), in 4 months after the surgery	78,5±4,7	37	-1,1+4,1	-1,01	17	0,33
Active sperms (%), 12 months after the surgery	79,18±4,91	37	1,8+0,24	-29,8	17	0,00

*- in comparison with the initial values

In general, hernia and hernioplasty negatively influenced the reproductive function in men, however, some spermogram parameters got normalized in the post-operative period. The circulation rate parameters in the spermatic cord vessels in patients with a direct hernia were similar to the ones in the group of patients without hernias; and in patients with an indirect, recurring inguino-scrotal hernia, the CMR values were decreased. In the post-operative period, the average rate of arterial circulation increased after the Desarda surgery. The difference in the rate of venous circulation before and after the surgery was insignificant (Table 5). It should be also mentioned that the circulation disorders remained for 5-6 years in patients that had Lichtenstein and Shouldice surgeries, which was shown on the Doppler sonography as an extension of the systolic peak and reduction of the arterial circulation linear rate. According to the obtained data, the main cause of testicle dysfunction was circulation failure.

Table 5. Arterial and venous blood pressure in vessels of spermatic cord before the surgery (M±n)

Parameter	Shouldice hernia repair, n=41		P	Lichtenstein hernia repair, n=39		P	Desarda hernia repair, n=50		P
	Before the surgery	After the surgery		Before the surgery	After the surgery		Before the surgery	After the surgery	
S art., cm/s	32.19±7.11	32.61± 1.91	p < 0.05	31.18±8.11	31.71±12.01	p < 0.05	32.12± 6.18	33.18± 6.99	p < 0.05
Mcan., cm/s	11.69± 3.01	12.61±4.18	p < 0.05	12.81± 2.87	13.81± 4.11	p < 0.05	12.79± 3.1	13.78± 7.17	p < 0.05
R1	0.86±0.20	0.84±0.18	p < 0.05	0.85± 0.18	0.83± 0.12	p < 0.05	0.83± 0.91	0.83± 0.17	p < 0.05
S ven., cm/s	11.67± 3.01	11.91±3.05	p < 0.05	11.98 ±3.17	11.98± 2.99	p < 0.05	11.48± 2.48	11.98± 3.12	p < 0.05
Δ%	10.18			14.81			8.10		

Three months after the surgery, patients who, had Shouldice and Desarda hernia repair performed, had an increase in CMR, the main parameter of testicular circulation, and decrease in R1 on the affected side, which was not observed in patients who had Lichtenstein surgery (Table 6). The circulation insufficiency also reduced. Better results were observed in patients who had Desarda hernia repair than in patients who had Shouldice and Lichtenstein surgeries. In patients who had Desarda hernia repair, improved circulation was observed in the spermatic cord and, as a result, the reduction of the residual circulatory insufficiency - 8.10%. A slightly higher deficit in circulation (9.81%) was observed in patients who had Shouldice hernioplasty. The patients who had Lichtenstein surgery had the highest residual deficit of blood circulation (14.81%) and the index of the resistance in these patients was 0.85. Thus, the choosing the method of hernia repair in young men should, the surgeons should take into account the advantages of the Desarda surgery to avoid the possible testicular complications. The data obtained from the analysis of the intensity of the pain syndrome by means of the visual analogue scale showed that the intensity of the pain syndrome in 70% of patients after the Desarda hernia repair did not exceed 3 points within the first day after the surgery, and on the 5th day after the surgery, in 8 patients (40%), the pain intensity was scored as zero. At the same time, in more than 83.3% of patients who had Lichtenstein hernia repair, the pain intensity was 4-5 points within the first day after the surgery and only in 21.8% of patients, the pain intensity on the 5th day after the surgery was 12.8%. On average, the inpatient time was 6.8 day in patients who had Desarda surgery and in patients who had Lichtenstein surgery. At the same time, in the early post-operative period in patients who had Desarda hernia repair, seroma was revealed in 2.5% and infiltrate in 3.8%. In 14 patients who had Lichtenstein hernia repair, there were some complications observed in the post-operative period: seroma – in 7.9%, infiltrate in the area of post-operative wound – in 9.6%, hydrocele – in 7.9%, which is 18.4%. Thus, Desarda hernia repair allows significant

improvement of the treatment outcome and reduce the negative effect of the inguinal canal repair on the testicular circulation. Three patients had recurring hernia within 2 years of the observation: 1 patient in the Lichtenstein surgery group and 2 patients in the Shouldice surgery group. There were no recurrent hernias observed in patients after the Desarda surgery. Average time spent in hospital was 8.5 ± 1.1 days after the Shouldice surgery, 7.1 ± 1.1 days after the Lichtenstein surgery and 6.9 ± 1.1 days after the Desarda surgery. The average time of observation was 48 months (in the range of 12 months).

DISCUSSION.

The treatment of an inguinal hernia in childhood or adulthood can lead to reproductive function failure in men [1,2]. The incidence rate of the reproductive pathology due to the complications after the hernia repair surgery is 0.7% [2]. An inguinal hernia in men is located close to the ductus deferens and failures in surgical techniques can lead to its obturation [3,4]. As a rule, iatrogenic obstruction of the ductus deferens and its consequences remain unrevealed until the patient applies for medical assistance due to infertility. Apart from the damage of the ductus deference, blood and lymphatic vessels and nerves of the spermatic cord can be damaged, which leads to ischemic orchitis, partial atrophy of a testicle and spermatogenesis failure. In the majority of cases, these complications exert the negative influence on the germinative function.

The rehabilitation of the reproductive health is one of the most important medical tasks because it determines the possibility to reproduce the population and preserve the genetic material. It is known that one of the possible causes of the reproduction function failure is the development of hernia or an inguinal hernia repair surgery. Presently, it is acknowledged that long-term presence of inguinal hernia affects the testicles [4,6]. Due to anatomical and topographical peculiarities of an indirect inguinal hernia, when the hernia sac and its content are adjoining the spermatic cord vessels, it negatively affects its anatomical structures [9]. Direct inguinal hernia,

when the hernia sac penetrates the inguinal canal outside the spermatic cord, affects the spermatic cord as it increases in size. Until now, the incidence rate of hernia recurrence after the hernia repair surgery was actually the only criteria of quality of the proposed surgical methods of treatment [1]. However, apart from the risk of recurrence, different surgical approaches are associated with the worsening of the quality of life of the patients of the reproductive age. The available published data indicate the significance of different factors that influence the reproductive health of male patients after the inguinal hernia repair [2,5]. During the past 20 years, the conventional view on inguinal hernias changed. The main criteria of the choice of hernioplasty technique are the condition of the back wall of the inguinal canal and the inner inguinal ring [12,13]. Hernioplasty developed by M.P. Desarda [1986] (a method of reinforcement of inguinal canal) differs significantly from the analogue techniques. It is based on the principle of “unattached” repair of the abdominal wall which is one of the basics of modern herniology. Presently, Desarda hernioplasty is not widely used, so its results are understudied [8].

The conducted study results showed the negative influence of mesh implant, especially polypropylene endogenic graft, on the reproductive organs of patients that had hernia repair surgery and provided rationale for further study of this issue. Thus, the choice of the method of hernioplasty for the men of reproductive age should include, along with other factors, the evident benefits of TAPP and Desarda methods. This method allows for the reduction of possible complications in the reproductive system, including the ejaculate fertility disorders and decrease in the androgens level.

Post-operative observation was similar and did not vary between the groups. The main complications after the hernioplasty in the post-operative period included seroma, hematoma in the area of the operation wound, neuralgia, hydrocele, the feeling of a foreign body, testicle atrophy, orchitis, orchiepididymitis, and wound infection. During the present study, the

following complications were revealed: seroma in 5 cases, orchitis, hydrocele and neuralgia in patients who had Lichtenstein hernia repair. The patients who had Shouldice hernia repair, had seroma in 5 cases, orchitis, postoperative wound infection and testicle atrophy (2 cases of each). The patients who had Desarda hernia repair had 1 case of seroma and 1 case of infiltrate. The analysis of the technical side of the studied methods showed that the least complicated were the Desarda and Lichtenstein techniques. Lichtenstein and Shouldice techniques are technically more complicated than Desarda technique and require certain training and experience from the surgeon. Often, the pain syndrome that develops after the Lichtenstein surgery in the early post-operative period is associated with the suturing or compression of the irreducible parts.

The results of the conducted study showed the most feasible of the studied methods of the surgery for a primary inguinal hernia was Desarda method due to its reliability, simplicity, and preservation of the reproductive function.

Desarda hernia repair is a low traumatic and technically simple approach that complies with the main principles of inguinal hernioplasty providing the no mesh repair of the inguinal canal. Due to the mentioned benefits, there is no failure of the blood circulation in the spermatic cord, which provides uncomplicated post-operative recovery. The authors developed the criteria for the comparison of the results of the performed surgeries. The main criteria were the changes in reproductive function, the diseases development after the hernioplasty and the post-operative complications.

The obtained data showed that both surgeries were successful and were performed as no mesh repair of tissues. The results of the Shouldice and Lichtenstein hernioplasty less depended on the anatomical changes in the inguinal canal. The outcome of the Desarda hernioplasty depends on the condition of the back wall of the inguinal canal, the size of the inguinal space and the type of a recurring hernia.

A direct correlation was observed between the incidence rate of the post-operative complications and the type of hernias in the

operated patients: $r = -0.42$ (Desarda), $r = -0.63$ (Lichtenstein) and $r = 0.68$ (Shouldice).

By the difficulty type, the inguinal hernia had insignificant negative correlation ($r = -0.74$) with the incidence rate of the post-surgical complications after the Desarda hernia repair and even less significant positive correlation with after the Lichtenstein ($r = 0.78$) and Shouldice ($r = 0.68$) inguinal canal repair.

Separate analysis of the wound and compression ischemic complications showed that the correlations between the patient's age and the degree of the destruction of the inguinal canal had opposite character.

After the Desarda surgery, the incidence rate of wound complications (1.7%) did not have expressed correlation with the type of hernia ($r < 0.3$).

After the Lichtenstein surgery, the increase in the difficulty of the inguinal hernia was associated with the increase ($r > 0.9$) in the rate of wound complications (5.8%), but there was no association between the similar analogue parameters ($r < 0.7$) and the compression ischemic complications. After the Shouldice hernia repair, the difficulty type of inguinal hernias was not significant ($p < 0.4$).

There are some limitations to the Desarda technique associated with the inguinal space and the possibility to immobilize effectively the aponeurosis of the abdominal external oblique muscle, if in difficult cases, Chernov's hook-shaped dissections are not performed. For Lichtenstein and Shouldice techniques, there are no such limitations.

The pain intensity parameters after the surgery depended on the tension of aponeurosis or graft to the pubic tubercle. Eight hours after the hernioplasty, the pain syndrome was observed in 76% of the patients who had Desarda surgery, in 89% - who had Lichtenstein surgery, and in 96% - who had Shouldice surgery.

Later, the pain intensity did not differ in patients who had Shouldice and Lichtenstein surgeries.

The performed analysis showed that the Desarda technique was associated with some tissue tension in around 10-15% of cases. In such cases, wave-like relaxation incision of the front wall of the abdominal rectus muscles sheath was

performed. After the incision, the post-operative pains relieved. After the Lichtenstein surgery, there were no cases of tension observed.

Shouldice hernia repair surgery was associated with higher tissue tension and pain intensity after the surgery.

In all the studied cases before the surgery, the patients with inguinal hernia should have the type of hernia to be identified, the condition of testicles evaluated, and the post-operative period monitored. Otherwise, false-negative results could be obtained and improper conclusions could be made.

CONCLUSION.

Desarda hernia repair can be used for planned and emergency surgery for patients of different groups. It was shown that the quality of life of patients who had Desarda hernia repair was better than of patients who had Lichtenstein or Shouldice surgery. The choice of the method of hernioplasty for men of reproductive age should include, along with other factors, the evident benefits of TAPP technique. The application of the autograft allows the surgeons to avoid the possible complications for the reproductive system, including ejaculate fertility disorders and decrease in androgens level. Desarda autografting of the inguinal canal requires further evaluation as an alternative technique of surgical treatment for inguinal hernia in patients of the reproductive age.

CONCLUSIONS:

- 1) Hernia is one of the causes of blood circulation disorders in the spermatic cord that affects the reproductive function in men.
- 2) After the Shouldice and Lichtenstein surgeries, the patients had higher residual deficit of blood circulation, as well as negative changes in the sperms count and their activity. Thus, these approaches cannot be considered as adequate methods of treatment for inguinal hernia in young men.
- 3) Desarda hernia repair is the optimal option for young men, and its application showed major perspectives in the solution of this problem.

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