Advantages of Isolation Hernioplasty in Modeled Inguinal Hernioplasty in an Experiment

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Abstract

Background: The Lichtenstein method revolutionized the treatment of inguinal hernias. Since then, many methods of hernioplasty have been proposed, of which the so-called isolation methods are gaining more and more relevance, which implies complete spermatic cord isolation from the mesh, in order to avoid the inclusion of the spermatic cord in the inflammatory process, which can cause a violation of the ejaculation function and spermatogenesis itself, as the Lichtenstein method is accompanied by such a serious Complications such as: development of fibrous changes in the spermatic cord, deejaculation, obstructive azoospermia, oligospermia. These complications have been proven by experimental and clinical studies, due to the close contact of the rope with the mesh and are conditions that contribute to infertility in men.

Aim: Study of subsequent changes in the vas deferens during modeled inguinal hernioplasty in the experiment, in the groups that underwent hernioplasty by Lichtenstein's method and complete spermatic cord isolation by Gvenetadze's method.

Material and methods: 16 male rabbits aged 12 months ± 3 months, weighing 3.5 ± 0.5 kg were included in the study. Of these, 8 (50%) underwent hernioplasty by Lichtenstein's method, and 8 (50%) - with spermatic cord isolation from a mesh by Gvenetadze's method.

Rabbits were divided into two groups. The first group: 8 rabbits, which underwent Lichtenstein's hernia surgery. The second group: 8 rabbits, which underwent hernioplasty with complete spermatic cord isolation by Gvenetadze's method. Vasography was performed in both groups 6 months after the operation, the patency of the ductus deferens and the degree of obstruction were studied.

Results: Our experimental study showed that changes in the vas deferens after the operation occurred only in the first group ($P<0.05$), no changes were observed in the second group. During the Lichtenstein method, <25% narrowing of the vas deferens was observed in 12.5%, 25-75% narrowing was observed in 50%, and >75% narrowing was observed in 37.5%. During the Gvenetadze method, no changes were observed in the vas deferens.

Conclusions: the experimental method showed the narrowing and interruption of the vas deferens during the Lichtenstein method, which is the reason for the development of obstructive azoospermia and oligospermia and contributes to the development of infertility in men. The mentioned experimental study reliably confirms the negative aspects of Lichtenstein's method, which should be taken into account, especially in men of reproductive age. The isolation method claims that these changes do not develop in the vas deferens, tension-free isolation hernioplasty is simple, prevents male infertility and does not affect spermatogenesis. **(TCM-GMJ December 2023; 8 (2):P32-P36);**

Keywords: Inguinal hernia; Vasography; Male infertility; Experiment.

Introduction

The problem of treatment of inguinal hernias remains relevant today (7).

Inguinal hernias are a widespread disease affecting 5-10% of the population (3). In the human population, inguinal hernias occur in 27-43% of men and 3-6% of women and account for 80% of all types of anterior abdominal wall hernias (8). Hernioplasty is one of the most common operations in surgery. Every year, more than 20 million inguinal hernia surgeries are performed worldwide: more than 700 thousand in the USA, up to 1 million in Europe, more than 200 thousand in Russia (7), up to 4000 in Georgia (9).

The classic method of open hernioplasty is hernioplasty according to Lichtenstein, using a polypropylene mesh (10). Since the introduction of this method in 1989, various alternative options for inguinal hernia repair with prosthetic material have been developed, but none of them have shown significant advantages in relation to this method, therefore today the Lichtenstein method is considered the "gold standard" of inguinal hernia repair (11).

Animals

Rabbits of the Californian breed included in the study, aged 12 months ± 3 months, weighing 3.5 ± 0.5 kg. Of these, (50%) hernioplasty was performed by Lichtenstein's method, and (50%) - with spermatic cord isolation from a mesh by Gvenetadze. All animals were maintained under appropriate light and temperature conditions before and after surgery, receiving ad libitum food and water throughout the study, which was conducted according to the NIH Guidelines for the Use of Laboratory Animals (n=16).

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Surgical procedure

Operations were performed under general anesthesia. Xylazine 2%, 0.5 ml/kg subcutaneously was used for premedication, a catheter was inserted into the ear vein. Anesthesia was performed by injection of somnopol (PROPOFOL 1% 1ml/kg) and xylazine (XYLAZIN BIO 2% 1ml/kg). Anesthesia was maintained by repeated injections of these drugs. After anesthesia, the skin was incised, the operative field was treated with Betadine. A 3 cm incision was made in the groin area. The skin, subcutaneous tissue was dissected, the spermatic cord was separated from the surrounding tissues. An UltraPro mesh with a size of 4x2cm was cut out and fixed on the surrounding tissues according to the methods of Lichtenstein and Gvenetadze. Mesh fixation was performed using 4/0 Prolene suture. Subsequent stages of the operation according to the methods of Lichtenstein and Gvenetadze. The wound was closed in layers, knotted sutures on the skin. Antibiotic therapy was not administered before or during the experiment. All animals were objectively monitored throughout the observation period and underwent daily clinical examination to evaluate local and systemic complications. Six months after mesh implantation, all animals (n=16) underwent reoperation. The abdominal wall was opened, the intra-abdominal part of the vas deferens was separated. It was transected 2 cm before entering the inguinal canal, urographin was injected into it to contrast the vas deferens, then a ligature was applied, and a vasography was performed. After that, the testicles together with the surrounding tissues (with the implanted nest) and the testis were excised as a single block and fixed in 10% formaldehyde.

Method with spermatic cord isolation from a mesh by Gvenetadze (fig. 1 a,b,c). fig. 2 Modeled inguinal isolation hernioplasty in experiment.

Integrity assessment of the vas deferens

Radiography was performed to assess the integrity of the vas deferens. Obstruction of the vas deferens were classified as minor (0-25% reduction in the diameter of the burner), medium (25-75%) and major (>75%) and its diameter was studied both in the areas in contact with the mesh and after. (fig. 3).

Results

After the operation, changes in the vas deferens developed only in the first group ($P<0.05$), no changes were observed in the second group. During the Lichtenstein method, <25% narrowing of the vas deferens was observed in 12.5%, 25-75% narrowing was observed in 50%, and >75% narrowing was observed in 37.5%. During the Gvenetadze method, no changes were observed in the seminiferous tubule. (fig. 4., Diagram 1., Table 1., Table 2).

Conclusion

Our experimental study showed the narrowing and interruption of the vas deferens during the Lichtenstein method, which is the reason for the development of obstructive azoospermia and oligospermia and contributes to the development of infertility in men. The mentioned experimental study reliably confirms the negative aspects of Lichtenstein's method, which should be taken into account, especially in men of reproductive age. The isolation method claims that these changes do not develop in the vas deferens, isolation hernioplasty is simple, prevents male infertility and does not affect spermatogenesis.

Discussion

According to the authors, patients who have undergone inguinal hernia repair may have vas deferens (0.3%). Unilateral obstruction of the vas deferens after inguinal hernia repair was observed in 6.65-26.7% of infertile patients (12). There is an opinion about the negative impact on spermatogenesis, both in hernia carriers and as a result of surgical interventions due to hernia (13). It is known that long-term presence of inguinal hernia in men of reproductive age leads to spermatogenesis disorders (14).

X. Chen et al. They treat obstructive infertility in men. During the 5-year period of work, 62 patients with obstructive azoospermia, the cause of which was inguinal hernia surgery in childhood, referred to them (15). Approximately 7.2% of men with obstructive azoospermia have a history of iatrogenic damage to the vas deferens. At the same time, the reason for 88% of men is surgical treatment of inguinal hernias. T. Mastuda et al. According to the data, in men with impaired germinal function and hernia in childhood, obstruction of the seminal duct occurs in 26.7% of cases (16).

O. Bouchot et al. According to data, vas deferens obstruction after hernioplasty without stretching occurs in 0.3-7.2% of cases (17). Japanese scientists described a clinical case of obstructive azoospermia that developed 5 years after bilateral inguinal hernia repair in a 30-year-old patient (18).

Results of a ten-year epidemiological study conducted in Sweden (n=34,267) show that only 0.7% of men develop male infertility after unilateral inguinal hernia. However, the authors admit that patients with bilateral inguinal hernias have an almost 5-fold increased risk of developing infertility (19).

M. Khodari et al. According to data, inguinal hernia repair using prosthetic material is the cause of obstructive azoospermia in 7.8% of cases (20).

In a study of the long-term results after inguinal hernia repair in men aged 18 to 37 years who were in a childless marriage for two years or more, 76.8% had changes in sperm count. At the same time, the number of spermatozoa and their movement decreased. 13% of patients had bilateral hernia in the anamnesis, in the remaining cases - unilateral. 70% of men had an operation before the age of 9 years, 12% of them showed swelling of the scrotum and

testicles in the early postoperative period, and ejaculation disorders in 33.7% (21).

Based on the study of literature sources, there are enough experimental scientific studies that describe the deterioration of spermatogenesis after operations in the groin area.

N.G.Kulchenko studied the morphological changes in the testicle after simulated inguinal hernia repair in an experiment. 20 male rabbits aged 120 days, weighing 3.8±0.9 kg were included in the study. Morphological evaluation of spermatogenesis was performed after 40 days. The study showed that 1.5 months after simulated inguinal hernia repair, the diameter of the convoluted tubules was 12.3% smaller compared to the control group ($p<0.05$). And the thickness of the spermatogenic epithelium of the flaked seminiferous tubules is 28.1% less compared to the control group ($p<0.05$) (22).

K. Junge et al. compared the performance of a light semi-absorbent polypropylene mesh (UltraPro) and a relatively heavy polypropylene mesh (Prolene). 6 months after modeling hernioplasty, the incidence of narrowing of the vas deferens lumen was evaluated, which was more than 75% in the areas in contact with the tissue mesh. The study showed that obstruction developed in rabbits 2 times more often when Prolene mesh was used compared to UltraPro (50% and 22.2% respectively). In addition, UltraPro mesh resulted in less inflammatory granuloma formation (23).

In most cases of tension-free hernia repair methods, there is close contact of the prosthetic material with the scrotum and its elements. According to Chen X. F. and co-authors, obstruction of the vas deferens can reach 26.7% in infertile men who underwent inguinal hernia repair in childhood (15).

D. Shin et al. described 14 cases of azoospermia in patients who underwent Lichtenstein inguinal hernia repair and concluded that the infertility was caused by the use of polypropylene mesh, which has the ability to obstruct the vas deferens (24). Later, L.Wang observed that out of 11 cases of azoospermia, the reason for its development in 7 patients was bilateral inguinal hernia repair (25).

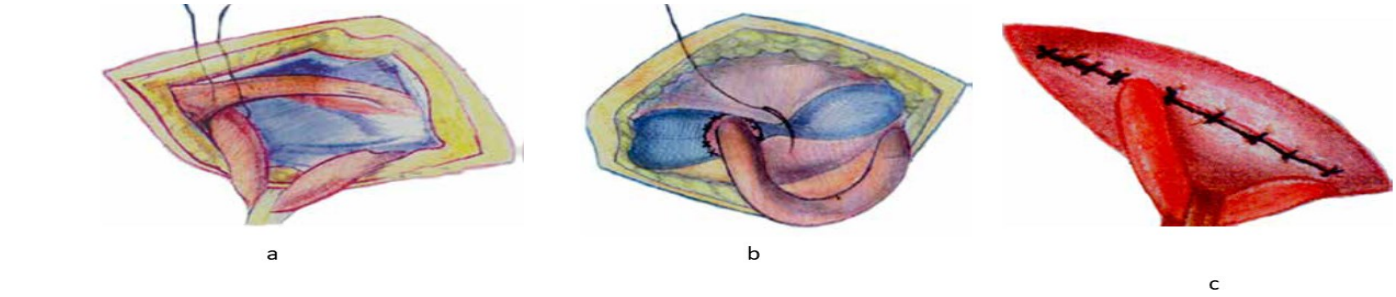

Figure 1: Method with spermatic cord isolation from a mesh by Gvenetadze: a)Narrowing of the inner ring of the inguinal canal. It is important and necessary to follow the transverse fascia in the burlap suture and the knot should be tied in such a way as to "tie" so as not to put pressure on the rope. b) A window should be cut in the net, which exceeds the diameter of the rope by 0.3-0.5 cm. The edges of the window are fixed to the inner ring of the inguinal canal with several knotted sutures. c) After the mesh is fixed, the aponeurosis is sutured behind the rope with a continuous suture. The rope is placed above the aponeurosis .

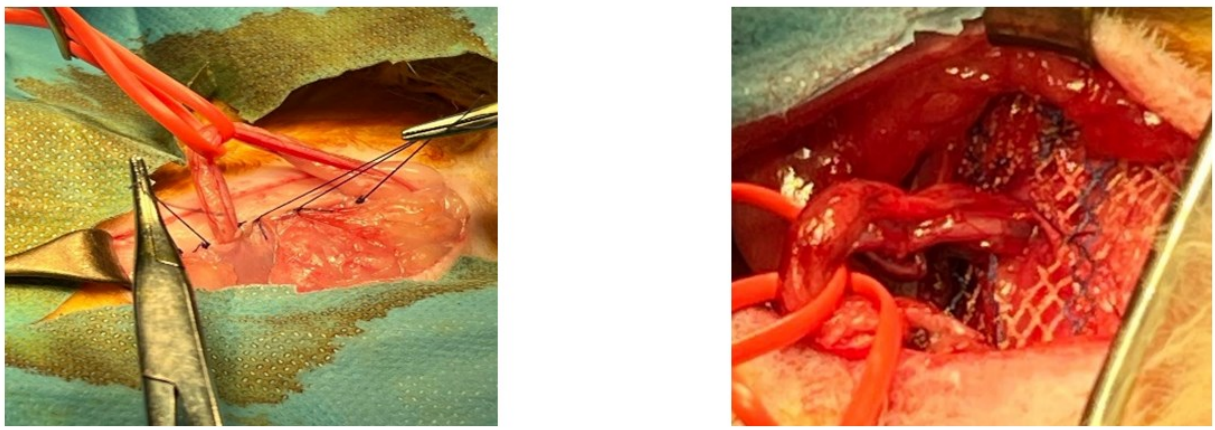

Figure 2: Modeled inguinal isolation hernioplasty in experiment: a) Inguinal isolation and hernioplasty with mesh; b) After the mesh is fixed, the aponeurosis is sutured behind the rope with a continuous suture. The rope is placed above the aponeurosis

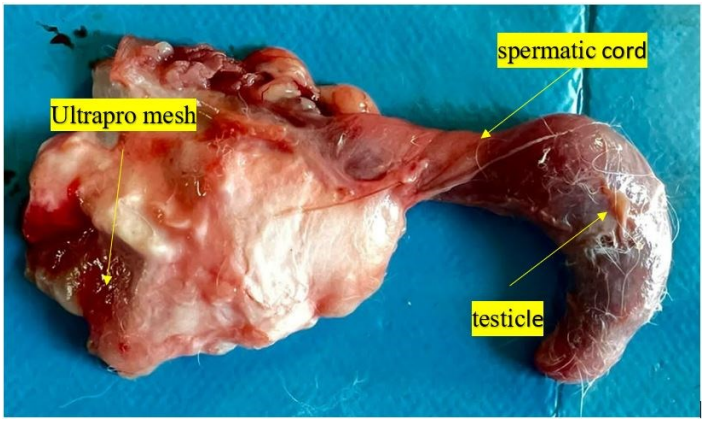

Figure3: Resected inguinal canal including testicie following injection of the X-ray solution

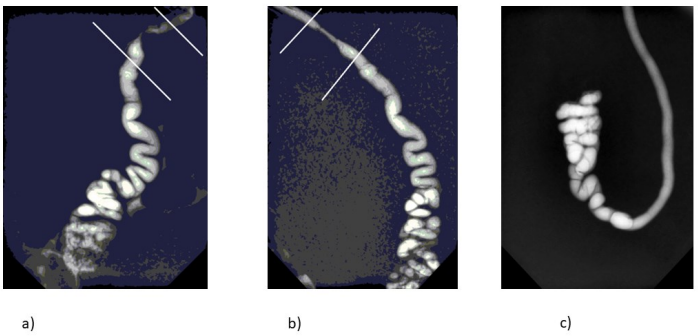

Figure 4: (a, b, c) Vasography after mesh implantation. a,b - Grid contact points are marked with lines. Obstruction sites are clearly visible after mesh implantation. c- Normal seminiferous tubule

Diagram 1. The size of the vas deferens 6 months after the operation (norm 2 mm)

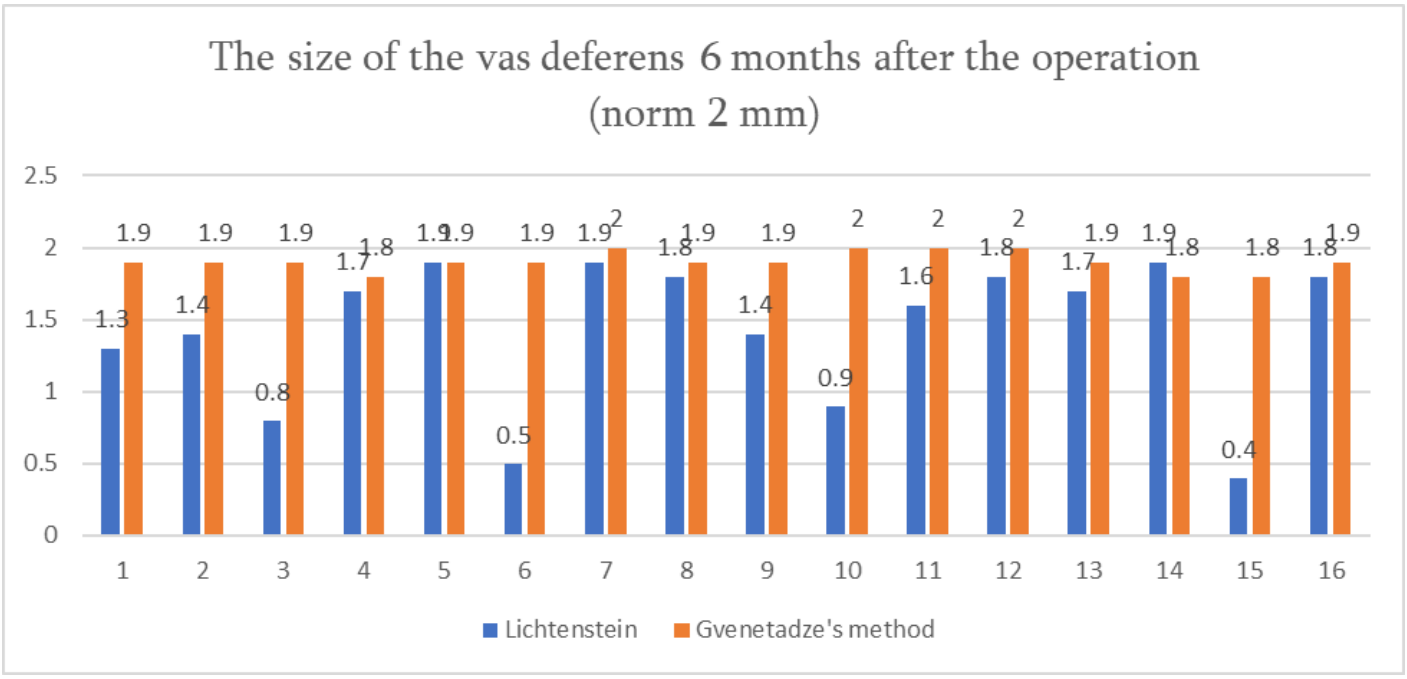

Table 1. Changes in the vas deferens after surgery occurred only in the first group (P<0.05), no changes were observed in the second group:

Method	Evarage	SD	P
Lichtenstein	1.4	0.5	P<0.05
Gvenetadze's method.	1.9	0.06	P>0.05

Table 2. Degree of obstruction of vas deferens detected by vasography after Lichtenstein and Gvenetadze method operation in percentage

Method	<25%	25-75%	>75%
Lichtenstein	12.50%	50%	37.50%
Gvenetadze's method.	100%	0%	0%

References

1. Ardia E, Gvenetadze T, Gorgodze T. Inguinal hernia and hernioplasty as a cause of male reproductive system dysfunction (review of literature). SCIENTIFIC JOURNAL „SPECTRI ". 2022 Jun 15;1.
2. Gorgodze T, Gvenetadze T, Ugrehelidze A, Taboridze I. Evaluation of quality of life after inguinal hernia repair. Black Sea Scientific Journal of Academic Research. 2019;44(1):57-60.
3. Gventadze T., Giorgobiani G., Gagnidze T., Kingsnorth A, Spermatic cord Isolation from a mesh avoids male infertility., 3rd International Hernia Congress., Boston. USA, June 7-11, 2006, p224
4. Kordzadeh A, Liu MO, Jayanthi NV. Male infertility following inguinal hernia repair: a systematic review and pooled analysis. Hernia. 2017 Feb;21:1-7.
5. Peiper C, Junge K, Klinge U, Strehlau E, Öttinger A, Schumpelick V. Is there a risk of infertility after inguinal mesh repair? Experimental studies in the pig and the rabbit. Hernia. 2006 Mar;10(1):7-12
6. Skawran S, Schmits B, Weghe D. Obstructive azoospermia after bilateral endoscopic total extraperitoneal inguinal hernia repair-the role of surgeon. Hernia. 2009;1(13):25
7. Magomedov MM, Imanaliev MR, Ismailov GM, Abdulaev UM, Magomedbekov RE. Evaluation of the results of various methods of prosthetic hernioplasty and criteria for predicting the development of early postoperative complications. Bulletin of new medical technologies. 2016;23(4) (Rus).
8. Ramshorst GH, HS Group. International guidelines for groin hernia management [J]. Hernia. 2018;22(1):1-65.
9. Public law legal entity L. Sakvarelidze National Center for Disease Control and Public Health. 2021 17 November #06/4914 (Geo).
10. Chartolani T. Open and laparoscopic prosthetic hernioplasty. 2009 Neomb. p. 35-36.(Geo).
11. Reinpold W, Chen D. Evidence-based Lichtenstein technique. Der Chirurg; Zeitschrift fur Alle Gebiete der Operativen Medizen. 2017 Apr 1;88 (4):296-302
12. Maciel LC, Glina S, Palma PC, Costa NF, Netto Jr NR. Histopathological alterations of the vas deferens in rats exposed to polypropylene mesh. BJU international. 2007 Jul;100(1):187-90
13. Sobennikov IS, Zhiborev BN, Kotans SY, Cherenkov AA. Diagnosis and treatment of male infertility in patients with common pathologies of the genitals and groin area. Russian Medical and Biological Bulletin named after Academician IP Pavlov. 2017;25(3) (Rus).
14. Gvenetadze T, Giorgobiani G, Archvadze V, Gulbani L. Prevention of the development of male infertility after various methods of inguinal hernioplasty using a mesh explant. Surgery news. 2014;22(3) (Rus).
15. Chen XF, Wang HX, Liu YD, Sun K, Zhou LX, Huang YR, Li Z, Ping P. Clinical features and therapeutic strategies of obstructive azoospermia in patients treated by bilateral inguinal hernia repair in childhood. Asian journal of andrology. 2014 Sep;16(5):745.
16. Matsuda T. Diagnosis and treatment of post-herniorrhaphy vas deferens obstruction. International Journal of Urology. 2000 May;7:35-8
17. Bouchot O, Branchereau J, Perrouin-Verbe MA. Influence of inguinal hernia repair on male fertility. Journal of visceral surgery. 2018 Jun 1;155:S37-40
18. Yamaguchi K, Ishikawa T, Nakano Y, Kondo Y, Shiotani M, Fujisawa M. Rapidly progressing, late-onset obstructive azoospermia linked to herniorrhaphy with mesh. Fertility and sterility. 2008 Nov 1;90(5):2018-e5
19. Hallén M, Westerdahl J, Nordin P, Gunnarsson U, Sandblom G. Mesh hernia repair and male infertility: a retrospective register study. Surgery. 2012 Jan 1;151(1):94-8.
20. Ramadan SU, Gokharman D, Tuncbilek I, Ozer H, Kosar P, Kacar M, Temel S, Kosar U. Does the presence of a mesh have an effect on the testicular blood flow after surgical repair of indirect inguinal hernia?. Journal of Clinical Ultrasound. 2009 Feb;37(2):78-81.
21. Lelchuk SA, Antonenko FF. Causes of male infertility. Andrology and genital surgery. 2009;10(2):95-1 (Rus).
22. Kulchenko NG. Morphological changes in the testicle after experimental modeling of inguinal hernia repair. Research'n Practical Medicine Journal. 2021;8(3):62-9 (Rus).
23. Junge K, Binnebösel M, Rosch R, Öttinger A, Stumpf M, Mühlenbruch G, Schumpelick V, Klinge U. Influence of mesh materials on the integrity of the vas deferens following Lichtenstein hernioplasty: an experimental model. Hernia. 2008 Dec;12(6):621-6
24. Shin D, Lipshultz LI, Goldstein M, Barmé GA, Fuchs EF, Nagler HM, McCallum SW, Niederberger CS, Schoor RA, Brugh III VM, Honig SC. Herniorrhaphy with polypropylene mesh causing inguinal vasal obstruction: a preventable cause of obstructive azoospermia. Annals of surgery. 2005 Apr;241(4):553
25. Wang L, Liu ZY, Piao SG, Xu CL, Hou JG, Gao X, Sun YH. Surgical treatment of azoospermia caused by iatrogenic injury to bilateral vas deferens. Zhonghua nan ke xue= National Journal of Andrology. 2016 Jul 1;22(7):626-9