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REVIEW

Influence of inguinal hernia repair on male fertility

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Summary Male infertility is a rare but certainly underestimated iatrogenic complication of inguinal hernia repair. The use of polypropylene mesh, recommended by the European Hernia Society, either via the traditional, open or laparoscopic approach, is responsible for surrounding inflammation followed by fibrosis, but there is no proven increase in vas deferens obstruction found in the literature. Prevention is essential to reduce the incidence of this complication including screening for patients at risk and mastery of surgical techniques.

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Inguinal hernia repair is one of the most commonly performed operations in general surgery. Over 20 million hernia operations are executed every year worldwide [1]. Because of the huge numbers, complications inevitably occur and potentially, some have an effect on fertility and in particular, on the quality of male ejaculate.

There is a paucity of literature regarding the consequences of inguinal hernia surgery on fertility, basically for two reasons:

- most inguinal hernia repairs are performed in men over 50, age for which fertility is rarely a cause for consultation and;
- vas deferens obstruction is an asymptomatic short term complication. The only symptomatic situations are those where an injury to the spermatic vascular pedicle is responsible for orchitis, which can lead to ischemic testicular necrosis.

Male infertility

Infertility is defined by the failure of a couple to achieve a pregnancy after 12 months of unprotected sexual intercourse. At the end of this period, the search for a cause requires that two sperm counts be performed on the male partner three months apart (spermatozoa production takes 74 days). When azoospermia is found on two consecutive sperm counts, this suggests some form of obstruction.

Obstruction, in fact, represents only 6% of all causes of azoospermia [2] but requires a full clinical examination. On physical examination, the testes are usually of normal size and consistency; on palpation, an enlarged epididymal head is occasionally present (most often in the case of bilateral agenesis of the vas deferens) or dilatation of the vas deferens may be found (frequently seen in men with previous vasectomy). Conversely, testicular hypotrophy, or atrophy, confirmed by sonographic measurement, calls for searching an associated hormonal etiology.

When taking patient history, one must search for previous surgical interventions, particularly in childhood (consultation of the health record): surgery for cryptorchidism or

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testicular ectopia, hydrocele with persistence of the processus vaginalis, testicular torsion or trauma, tumor or pediatric inguinal hernia repair.

Azoospermia requires a complete hormonal workup, including serum testosterone, FSH and LH. In case of spermatic obstruction, these investigations are usually normal; in the case of associated hormonal disorders, compensatory FSH hypersecretion can result in a normal testosterone level (hypothalamic pituitary regulation).

Routine search for the ABCC7 (formerly CFTR) mutation is not mandatory in patients with clinically detectable vas deferens in association with obstruction.

Obstructive azoospermia is possible only when:

- obstruction of the deferential duct is bilateral, as in bilateral vas deferens agenesis, vasectomy, and occasionally inguinal canal surgery;
- or, in the case of unilateral obstruction, when the other vas deferens is either congenitally absent or atrophic due to major atrophy following vascular injury or bacterial orchitis.

Inguinal hernia repair

A history of inguinal hernia repair should be routinely sought in all infertile men and cross-checked with health records. Physical examination should also diligently search for scar at the level of the inguinal canal.

The spermatic cord, which includes the vas deferens, the spermatic artery and the pampiniform plexus, lymphatic vessels and nerves (the genital branch of the genitofemoral nerve, the ilioinguinal nerve and the sympathetic nerves of the testicular plexus), traverses the inguinal canal. During hernia surgery, the risk of iatrogenic injury can involve:

- the vas deferens, either by external fibrosis to various degrees, leading to loss of deferential muscular contraction or to direct trauma with limited stenosis;
- the vessels, increasing the risk of ischemic orchitis, testicular atrophy or endocrine disorders.

Inguinal hernia repair techniques: two types of procedures have been developed:

- reconstruction of the inguinal wall with tissue-based sutures on native anatomic structures, among which the Shouldice technique remains a gold standard. This technique, based on reconstruction of the posterior wall of the inguinal canal and internal ring with several planes of non-absorbable sutures, is reputed for low recurrence rates in expert centers (0.7–1.7%), but seems to be fraught with higher long-term recurrence rates in overall general practice (1.7–15%) [3,4];
- reinforcement of the inguinal wall with a synthetic mesh, based on the principle of tension free repair. In 1989, Lichtenstein introduced the concept of tension-free repair with a polypropylene mesh for all primary inguinal hernias. Mesh repair can be performed through a direct anterior approach or a posterior laparoscopic approach. The mesh is placed on the posterior wall of the inguinal canal, anterior to the transversalis fascia (Lichtenstein) or posterior to the transversalis fascia (laparoscopic). Currently, laparoscopic insertion of a polypropylene mesh via the extra-peritoneal approach is considered the reference for laparoscopic hernia repair [5]. The advantages of this technique, above all in case of bilateral repair, are the low recurrence rates (0.2–0.6%), possibility of ambulatory management and high patient satisfaction [6,7].

Infertility and inguinal hernia repair

When polypropylene mesh is inserted, a dense fibroblastic inflammatory reaction is created between the monofilament incorporated into the mesh and the surrounding tissues. This reaction consolidates the floor of the inguinal canal and contributes to decreasing the recurrence rate. Because of this strong reaction, the different elements of the spermatic cord, and in particular, the vas deferens, close to the anterior aspect of the mesh, can be involved in the scar formation in certain situations.

Uzzo et al. studied the local reaction of polypropylene mesh on the spermatic cord in 12 male Beagle dogs, comparing the histological and clinical aspects of tissue-based and mesh hernia repairs [8]. No difference in testicular volume, scrotal temperature or vascular flow was found between the two groups. Nonetheless, there was a significant decrease in the lumen diameter of the vas deferens in both treated groups compared to a control group. The authors concluded that there was a true effect of the fibroblastic reaction on the spermatic cord and in particular, on the vas deferens. Although the sperm counts were normal at one year (and in particular, after mesh repair), the authors could not exclude the possibility of long-term obstruction.

The prevalence of obstruction of the vas deferens after inguinal hernia surgery is not known with precision. The figures reported in the literature come from older studies and range between 0.3 and 7.2% [9,10]. More recently, Shin et al. reported a series of 14 patients with obstructive azoospermia, diagnosed after prosthetic mesh hernia repair, performed in eight surgical centers in the United States between 1988 and 2002 [11]. Khodari et al. identified 879 patients with azoospermia among 9740 new patients that consulted for infertility between 1990 and 2011 in an andrology center [12]. Of these, 69 had obstructive azoospermia with an antecedent inguinal hernia repair performed after puberty (7.8%). Patients undergoing inguinal hernia repair in infancy were not included. In this study, the most important findings were:

- mean age at the time of hernia repair was 26.4 ± 5.0 years and mean age at the beginning of management for infertility was 34.1 ± 7.0 years, i.e. a mean delay of eight years. For 84% of patients, infertility was primary while for the other 16%, it was secondary;
- hernia repair was bilateral in 40.6% of patients and unilateral in 59.4%. Repair was anterior without mesh in 18, anterior with mesh in 12 and laparoscopic with mesh in 11 patients (in 22 patients, the technique was not mentioned).

While synthetic material used for hernia repair is responsible for fibrosis and scar formation in the pre-peritoneal space, it can also induce discomfort and chronic pain. Causality of infertility, however, remains unproven.

Yamaguchi et al. reported the case of a 30-year old patient who presented with obstructive azoospermia five years after bilateral hernia mesh repair [13]. The authors concluded that young patients capable of procreation should not be treated with mesh repair.

In a prospective survey where a questionnaire was addressed to 376 men between 18 and 55 years old treated by bilateral mesh repair, compared to 186 men treated for inguinal hernia without mesh and a control group of 383 men from the general population, Hallen et al. were unable to confirm the hypothesis that there was a relationship

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