Can We Be Sure Polypropylene Mesh Causes Infertility?

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Just when most experts were thinking that the problem of recurrence had been all but eliminated for primary inguinal herniorrhaphy because of the tension-free mesh concept, along comes this disturbing manuscript by Shin and colleagues incriminating the mesh fibrotic reaction as a cause of infertility. Fourteen patients are presented with infertility secondary to obstructive azoospermia (normal sperm in a testicular biopsy yet no sperm in the ejaculate) felt to be related to the fibroplastic involvement of the vas deferens after a heterogeneous group of mesh repairs (conventional, laparoscopic, unilateral, bilateral). All patients underwent surgical exploration with intraoperative vasography. The vasogram determined the site of the obstruction in the inguinal region, and the surgical exploration identified the cause of the obstruction to be the mesh. The editors of the *Annals of Surgery* have rightfully chosen to publish this work, which essentially amounts to pooled case reports (level IV evidence) because of the seriousness of the implications and the reputations of the authors who are leaders in field of male infertility. I concur completely with the editors' decision.

The question inguinal hernia surgeons must ask is what to do with this information. Infertility caused by inguinal hernia surgery is a recognized complication. The cause of the infertility can be related to either the vas deferens or the testicle. The incidence of injury to the vas deferens during inguinal herniorrhaphy has been estimated at 0.3% for adults and between 0.8% and 2.0% for children.[1] Injury to the testicle, which eventually leads to atrophy, is estimated to occur in about 0.5% for primary hernia repairs but increases 10-fold to 5% for recurrent repairs.[2,3] Ironically, one of the major arguments for the routine use of mesh in inguinal hernia surgery is to preserve fertility. The theory is that by decreasing the generally accepted recurrence rate in the general population from 10% to 15% seen with Bassini and its variants to less than 5% with the mesh tension-free approach, reoperative surgery, with its heavy toll of testicular loss, is avoided.

We know the overall incidence of infertility after inguinal herniorrhaphy is higher than that of the general population. Yavetz et al[4] looked at 8500 infertile patients and found that 565, or 6.65%, gave a history of an inguinal hernia repair. However, this does not shed any light on the incidence of the infertility caused by the operation. The issue is clouded by the fact that many herniorrhaphy patients have no intention of conceiving a child, so fertility status cannot be known. Further, the fertility status of the patient prior to herniorrhaphy is usually not known, and the time period between the herniorrhaphy and the diagnosis of infertility introduces the variable of intervening causation. We must look to investigators like Shin and colleagues who conduct specialty infertility clinics to try to extrapolate the incidence. But that literature is dominated by case reports or small series, calling into question the quality of the estimates.[5] It is possible that the incidence is so low

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that the fertility advantages of mesh repair as the result of avoiding reoperation for recurrence outweighs the risk.

The title of their manuscript leaves no doubt that the authors feel that the mesh caused the obstruction of the vas in the 14 patients reported. But is this the case? Experienced surgeons who perform reoperative groin explorations after mesh inguinal hernia repairs for other issues than fertility such as recurrence or postherniorrhaphy groin pain know that the intense fibrotic response described in the manuscript is invariably present. Polypropylene and the other mesh materials used in hernia surgery are supposed to incite a dense fibroplastic tissue response for the purpose of creating a strong mesh-aponeurotic complex to replace weakened native tissue. Eight hundred thousand groin hernia repairs are performed annually in the United States, of which approximately 90% are now mesh repairs.[6] Given the fact that inguinal hernias occur at all ages of life and inguinal herniorrhaphies are performed in sizable numbers of patients who are still planning to bear children, why then are we not seeing an epidemic of infertility? Do these 14 patients represent a subset that is exquisitely sensitive to the normal fibroblastic response to mesh? Or was the real cause of the vasal obstruction described in this manuscript the result of a more traditional injury (division, ligation, clipping, stapling, electrocauterization, devascularization) followed by scarification to the most convenient structure, which, in this case, was the mesh?

If one were to assume that polypropylene mesh does indeed cause obstruction of the vas, then one logically must consider the mechanism. Is it caused by an exaggerated fibroblastic response in some patients? If so, why isn't the entire structure obliterated? Or does it have only to do with sites where the vas comes in contact with edges of the mesh? It should then only occur at the external and internal rings where the cord rides over these edges. And would the modified Lichtenstein operation, in which the tails of the split mesh are simply approximated lateral to the cord at the internal ring, put the patient at greater risk than the classic operation, in which the inferior surface of the superior tail is sutured to the inferior surface of the inferior tail and the inguinal ligament, which creates a shutter-valve effect? The authors make recommendations in their discussion section concerning methods to protect the vas, but I can't help but feel that these represent little other than pure speculation until the mechanism question is answered.

In some ways, this manuscript raises more questions than it answers, just as previous case reports that ostensibly show a relationship between mesh and vas injury. As a student of inguinal hernia surgery for much of my career, I have reviewed these reports carefully and found myself not always agreeing with the pathophysiology proposed by the authors. For example, an often-quoted case report by Silich and McSherry[7] describes a patient who presented 4 years after an inguinal herniorrhaphy with a painful subcutaneous nodule in the repair site. At groin exploration, the patient was found to have a spermatic granuloma "imbedded in surrounding fibroareolar tissue and mesh." The authors concluded that cut edges of the mesh where the tails had been wrapped around the cord eroded into the cord and even provided a diagram depicting this, despite the fact that the original operation was performed at "an ambulatory surgery center" and no details of the original operation were available. In my mind, an isolated injury to the vas deferens was the more likely explanation as a spermatic granuloma is, by definition, an immunologic response to extravasated sperm. It seemed to me that a direct injury to the vas, resulting in a sperm leak, was a more plausible explanation than gradual erosion by the edge of the mesh.

Similarly, a case report published by Seifman et al[8] is often purported to show unequivocal evidence that mesh can cause obstruction of the vas. The 32-year-old patient was diagnosed with secondary infertility (infertility which develops after a successful conception) 1 year after a right inguinal hernia repair with mesh. The patient underwent a groin exploration after he was determined to have obstructive azoospermia on the right based on the absence of viable sperm in a seminal vesical aspirate compared with a right-testicle aspirate showing many sperm. An isolated segment of vas was resected that was "incorporated into a scarification process involving the mesh and the vas was totally obstructed" and a reconstruction performed. The patient successfully conceived a child 6 weeks later. It seems pretty clear: the site of blockage was identified precisely, the problem corrected surgically, and the proof was available because the patient was almost immediately able to conceive a child. However, what is commonly omitted when this article is referenced is that the patient also underwent a simultaneous varicocelectomy on the opposite side. The authors felt that the short time interval between the varicocelectomy and the conception was too brief to have any effect. It must be left to the reader to decide whether the correction of a known cause of infertility, a varicocele, or a technically challenging reconstruction was responsible for the pregnancy.

And what about the medicolegal consequences? Does the Shin manuscript demand that patients be told that the use of mesh may specifically cause infertility? We as surgeons have an obligation to provide our patients with appropriate informed consent. We could spend hours giving informed consent because the list of possible complications is endless, especially if one felt inclined to include general complications common to any surgical procedure, anything from an attack of gout to falling off the operating table. We don't do this, because we also have an obligation not to unnecessarily alarm patients, some of whom may not be capable of placing an extensive litany of possible complications into proper perspective. In effect, they might be deprived of a procedure which could truly improve their quality of life. I was taught

in my residency to use a 1% rule in determining what should and should not be included in an appropriate informed consent discussion, and I feel this has served my patients well throughout my subsequent career. The 1% principle means that if a complication occurs less than 1% of the time for a given procedure, it should not be specifically included in a proper informed consent, although it may be bundled in a group of complications which, in aggregate, crosses the 1% threshold. For the case in point, a general discussion about all spermatic cord and testicular problems, any of which could eventually lead to infertility, is held with the patient but does not include specific mechanisms (eg, I might cut your vas, I might ligate your vas, I might electrocauterize your vas, I might disturb the blood supply to your vas).

But based on the Shin paper, do I now need to tell them specifically that they may have a reaction to the mesh, which could cause them to be infertile? Although Shin's findings are enlightening and certainly provide an invitation for further study, I personally do not believe they are conclusive enough to demand that surgeons change their informed-consent discussion to include a specific warning about mesh. Infertility is a known complication of inguinal hernia surgery with or without mesh, and we tell our patients that. This is not just a matter of the inconvenience of prolonging the informed consent process because, as noted above, a return to the routine use of the Bassini operation or one of its nonprosthetic variants will inevitably lead to the need for more reoperative surgery for recurrence, which places the patient at the greatest risk of loss of fertility as a consequence of testicular atrophy.

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