Mesh-related infections after pelvic organ prolapse repair surgery

Matthew E. Falagas a,b,*, Stamatios Velakoulis a, Christos Iavazzo a, Stavros Athanasiou a,c

a Alfa Institute of Biomedical Sciences (AIBS), Athens, Greece
b Department of Medicine, Tufts University School of Medicine, Boston, MA, USA
c 1st Department of Obstetrics and Gynecology, Athens University School of Medicine, Athens, Greece

Received 14 September 2006; received in revised form 20 February 2007; accepted 27 February 2007

Abstract

The use of vaginal meshes has been an advance in the surgical management of women with pelvic organ prolapse. We reviewed the literature to synthesize the evidence regarding the infectious complications related to this new type of foreign body.

We searched PubMed, current contents, and references of initially identified relevant articles and extracted data regarding the incidence, clinical manifestation, and management of vaginal mesh-related infections. The incidence of mesh-related infections and erosion ranged from 0 to 8%, and 0 to 33%, respectively, in the published studies. Various factors influence the development of vaginal mesh-related infectious complications such as the kind of biomedical material (e.g. filament structure, pore size) of the mesh, the type of procedure, the preventive measures taken, and the age and underlying comorbidity of the treated women. Non-specific pelvic pain, persistent vaginal discharge or bleeding, dyspareunia, and urinary or faecal incontinence are the most common manifestation of vaginal mesh-related infection. Clinical examination may reveal induration of the vaginal incision, vaginal granulation tissue, draining sinus tracts, and prosthesis erosion or rejection. Various pathogens have been implicated, including Gram-positive and Gram-negative aerobic and anaerobic bacteria. The management of mesh-related infections in women who underwent pelvic organ reconstruction is combined surgical and medical treatment.

Although the use of vaginal meshes has become a new effective method of pelvic organ prolapse surgery clinicians should be aware of the various post-operative complications, including mesh-related infections.

© 2007 Elsevier Ireland Ltd. All rights reserved.

Keywords: Foreign body; Uterine prolapse; Cystocele; Vaginal vault prolapse; Erosion

Contents

1. Introduction ................................................................. 148
2. Literature search ........................................................ 148
3. Types of vaginal meshes ............................................. 148
4. Mesh-related non-infectious complications .................. 148
5. Mesh-related infectious complications ......................... 152
5.1. Incidence ................................................................. 152
5.2. Clinical manifestations ............................................. 153
5.3. Microbiology .......................................................... 153
5.4. Prevention .............................................................. 154
5.5. Diagnosis and treatment .......................................... 154
6. Conclusion ............................................................... 155
References .................................................................... 155

* Corresponding author at: Alfa Institute of Biomedical Sciences (AIBS), 9 Neapoleos Street, Maroussi 15123, Greece. Tel.: +30 694 61 10 000; fax: +30 210 68 39 605.
E-mail address: m.falagas@aibs.gr (M.E. Falagas).

0301-2115/$ – see front matter © 2007 Elsevier Ireland Ltd. All rights reserved.
doi:10.1016/j.ejogrb.2007.02.024
1. Introduction

Pelvic organ prolapse (POP) is a common disorder that occurs in up to 50% of parous women, although only 10–20% of them develop symptoms [1]. Several risk factors are associated with development of female POP, including childbirth, hypoestrogenism, obesity, connective tissue disorders, congenital diseases, and diseases and conditions such as chronic obstructive pulmonary disease, constipation, and heavy lifting that increase intra-abdominal pressure [2]. Olsen et al. reported that a woman has a lifetime risk to undergo a surgical repair of pelvic organ prolapse of 11.1% and a second operation is needed in 29.2% of cases [3].

Traditional pelvic reconstructive surgery for POP seems not to be very effective in preventing recurrences (33–45% recurrence rate in some studies) [4,5]. This disappointing result is mainly attributed to the poor quality of tissues used to reconstruct pelvic floor defects. Recently, after the wide use of meshes in general surgery, application of meshes for the surgical treatment of women with POP and/or stress urinary incontinence, has become common with the aim to improve tissue strength and support.

The limited available evidence suggests that the use of vaginal meshes has improved the outcome of women with surgical repair of POP compared to that of women with repair without the use of a mesh. For example, Sand et al., observed a significant reduction of recurrence of cystocele when a surgical mesh was used in a prospective randomized trial comparing anterior and posterior colporrhaphy with and without absorbable mesh (Vicryl) [6]. Also, Maher et al. in a meta-analysis, also supported that use of a polyglactin mesh for anterior vaginal wall repair reduces the possibility of recurrence of cystocele [7]. However, the use of vaginal mesh is not without complications. In this review, we tried to evaluate the available evidence regarding complications related to the use of meshes in the surgical repair of POP focusing on mesh-related infections (incidence, clinical manifestations, and management).

2. Literature search

Two reviewers independently performed the literature search, identified the relevant studies to be included in the review and extracted the data. Any disagreement between the reviewers was discussed in the meetings of all authors. Relevant studies (from 1988 up to April 2006) for inclusion in this review were identified through PubMed database literature searches. The search terms we used were ‘vaginal’, ‘mesh’, ‘infection’, ‘pelvic prolapse surgery’, ‘vault prolapse’, ‘infectious complications’, ‘biomaterials’, ‘antibiotic prophylaxis’, and ‘prevention’. Articles written in English, French, and Italian were reviewed. Studies of various methodologies were included in our review. Only studies involving the use of mesh in POP surgery were included. Studies focusing on the surgical treatment of urinary incontinence with the use of sling and tension-free vaginal tapes were excluded from our review as we were trying to focus on meshes used in POP surgery.

3. Types of vaginal meshes

Vaginal meshes currently used in female POP surgery, are either synthetic biocompatible meshes (for example, polypropylene) or biological meshes (for example, porcine dermis or porcine intestinal submucosa meshes or bovine pericardium meshes) [8]. Vaginal meshes are also classified as non-absorbable (polypropylene, expanded or not-expanded polytetrafluoroethylene, and polyethylene) and absorbable (polyglactin and polyglycolic acid) [8]. Structurally all meshes used for the surgical management of POP are multifilament, except for the polypropylene meshes that may be mono- or multifilament [8]. Meshes are classified in four categories (Amid 1997) based on their pore size and filament structure: type 1 (macroporous meshes, >75 μm, such as Prolene, Gynemesh PS, Gynecare TVT, and Sparc), type 2 (microporous meshes, <10 μm, such as Gore-Tex), type 3 (macroporous multifilament meshes or with microporous, such as IVS, Uratep, Surgipro, Mersilene, and Parietex), and type 4 (hypo-microporous meshes, <1 μm) [8].

4. Mesh-related non-infectious complications

The use of grafts in gynaecological surgery implies some important differences compared to the meshes used in other surgical procedures. First, the aim of vaginal meshes is not to occlude only a hernial defect but to provide support and allow sexual activity without pain. Second, vaginal meshes are foreign bodies that are introduced vaginally through a non-sterile environment and this theoretically could increase the probability of infection. Consequently, use of vaginal meshes in female pelvic organ prolapse surgery, is occasionally followed by early or late post-operative complications such as seromas, adhesions, chronic severe pain, dyspareunia, erosion or rejection of the mesh, as well as mesh-related infections.

Development of biomedical materials has led to the production of relatively inert and biocompatible surgical meshes. However, these materials can trigger various local tissue responses as well as dysfunctional changes when implanted in the human body. Local responses include foreign body reaction, fibrosis with subsequent tissue contraction, calcification, thrombosis, erosion, and fistulas such as vesico-vaginal or recto-vaginal fistulas [9,10]. Dysfunctional changes could involve the lower urinary tract, vagina, and anorectum. Obstructive voiding difficulties due to urethral overcorrection, de novo detrusor overactivity and urinary incontinence, dyspareunia, local chronic pain, as well as ileus and dyschaesia have been reported [11].
Table 1
Characteristics of the reviewed studies including data regarding vaginal mesh-related infectious complications

<table>
<thead>
<tr>
<th>Reference, type of study</th>
<th>Number of population, type of prolapse</th>
<th>Mean follow-up (in months)</th>
<th>Surgical technique</th>
<th>Type of mesh</th>
<th>Mesh-related infectious complications</th>
<th>Mesh-related non-infectious complications</th>
<th>Mesh erosion or/rejection</th>
<th>Treatment of infectious complications</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deffieux et al. [14], retrospective comparative study, France</td>
<td>138, cystocele (Gynemesh group), 71 (Gynemesh-Soft group)</td>
<td>32.1</td>
<td>Transvaginal repair of cystocele with tension-free polypropylene mesh</td>
<td>(1) Gynemesh 89/138 (64.5), (2) Gynemesh-Soft 49/138 (35.5)</td>
<td>Mesh infection 0/138 (0), urethra or bladder infection 0/138 (0)</td>
<td>De novo dyspareunia 141/138 (10), shrinkage of the Gynemesh 3/89 (3), shrinkage of the Gynemesh-Soft 0/49 (0)</td>
<td>Vaginal erosion with Gynemesh 1/59 (16), vaginal erosion with Gynemesh-Soft 12/49 (24), bladder or urethral erosion 0/138 (0)</td>
<td>Initially treated with intravaginal oestrogen and/or local antiseptics 18/27 (67), partial excision of the mesh 13/27 (48), complete excision of the mesh 2/27 (7)</td>
<td>Age &gt; 70 years is an independent predictive factor of vaginal erosion</td>
</tr>
<tr>
<td>Belot et al. [36], retrospective study, France</td>
<td>277, pelvic prolapse grade III (ICS classification)</td>
<td>ND</td>
<td>Vaginal approach with tension-free polypropylene mesh</td>
<td>(1) Prolene Mesh 108/277 (39), (2) Prolene Soft 169/277 (61)</td>
<td>ND</td>
<td>ND</td>
<td>Erosion, prosthesis exposure and defective vaginal healing 34/277 (12)</td>
<td>ND</td>
<td></td>
</tr>
<tr>
<td>De Tayrac et al. [15], descriptive case-series, France</td>
<td>84, anterior vaginal wall prolapse</td>
<td>24</td>
<td>Repair of anterior vaginal wall prolapse reinforced with tension-free polypropylene mesh and associated with vaginal hysterectomy and/or sacropinous suspension and/or posterior repair</td>
<td>Tension-free polypropylene</td>
<td>Mesh infection 0/84 (0)</td>
<td>De novo dyspareunia in 30 sexually active women, including 2 with vaginal erosion 5/30 (17), de novo urgency in women with anterior repair without TVT 3/44 (7), de novo voiding difficulties among women with anterior repair without TVT 0/56 (0)</td>
<td>Vaginal erosion 7/84 (8)</td>
<td>Partial excision of the mesh 47/57 (37), local antiseptic treatment 37/43 (43)</td>
<td>The only mesh-related post-operative complication was vaginal erosion</td>
</tr>
<tr>
<td>Lim et al. [16], ambispective study, Australia</td>
<td>90, posterior vaginal wall prolapse</td>
<td>1.5–4 months and then 6 months and beyond</td>
<td>Posterior colporrhaphy</td>
<td>Vicryl-prolene</td>
<td>Mesh infection in the first 4 months post-operatively 0/90 (0)</td>
<td>Hematoma 2/90 (2), lump sensation 1/78 (1), constipation 2/78 (3), defecation difficulties 1/78 (1), dyspareunia 2/59 (3)</td>
<td>Vaginal erosion in the first 4 months post-operatively 7/90 (13), new onset of vaginal erosion in 6 months and beyond post-operatively 2/31 (6)</td>
<td>Trimming of mesh 6/7 (86), trimming of mesh 4/4 (100), resolved spontaneously 1/7 (14)</td>
<td>Dyspareunia improved significantly post-operatively (p &lt; 0.001), defective vaginal healing in 27 (29) women with vaginal erosion</td>
</tr>
<tr>
<td>Milani et al. [24], multicenter prospective observational study, Italy</td>
<td>63, anterior or posterior vaginal wall prolapse</td>
<td>17</td>
<td>Anterior repair (32/63) or posterior repair (31/63), plus a polypropylene (Prolene) mesh</td>
<td>Polypropylene (Prolene)</td>
<td>Recurrent urinary tract infection 6/32 (20), pelvic abscess 1/31 (3)</td>
<td>De novo dyspareunia 4/32 (12.5), de novo fecal incontinence 1/31 (3)</td>
<td>Vaginal erosion in anterior repair 4/32 (13), vaginal erosion in posterior repair 2/31 (6.5) (pelvic abscess in one of them)</td>
<td>Removal of eroded mesh in the case of pelvic abscess</td>
<td>Authors believe that the use of prolene mesh should be abandoned</td>
</tr>
<tr>
<td>Reference, type of study</td>
<td>Number of population, type of prolapse</td>
<td>Mean follow-up (in months)</td>
<td>Surgical technique</td>
<td>Type of mesh</td>
<td>Mesh-related infectious complications</td>
<td>Mesh-related non-infectious complications</td>
<td>Mesh erosion or/and rejection</td>
<td>Treatment of infectious complications</td>
<td>Comments</td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------------------------------------</td>
<td>---------------------------</td>
<td>--------------------</td>
<td>-------------</td>
<td>--------------------------------------</td>
<td>------------------------------------------</td>
<td>-------------------------------</td>
<td>--------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Nicita et al. [17], retrospective study, Italy</td>
<td>24, total genitourinary prolapse</td>
<td>31.1</td>
<td>Uterus-sparing transvaginal surgery using synthetic biomaterials</td>
<td>Synthetic mesh of mixed polypropylene and 910 polyglactin fibers</td>
<td>Mesh infection 0/24 (0)</td>
<td>ND</td>
<td>Mesh erosion 0/24 (0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bader et al. [18], prospective study, France</td>
<td>40, cystocele grade II (8/40) or III (32/40)</td>
<td>16.4</td>
<td>Vaginal approach with a tension-free transversal polypropylene mesh (sub-bladder interposition)</td>
<td>Tension-free polypropylene mesh (Gynemesh)</td>
<td>Mesh infection 0/40 (0)</td>
<td>ND</td>
<td>Vaginal erosion 2/40 (5), complete mesh exposition 1/40 (2.5)</td>
<td>Secondary ablation of exposed mesh</td>
<td></td>
</tr>
<tr>
<td>Biertho et al. [25], prospective single-institution non-randomized trial, Belgium</td>
<td>34, rectoceles (n = 27), enteroceles (n = 26), cystoceles (n = 15), and hysteroceles (n = 9)</td>
<td>3 ± 2 months</td>
<td>Intravaginal slingplasty (IVS)</td>
<td>Polypropylene multilaminate tape</td>
<td>0/34 (0)</td>
<td>0/34 (0)</td>
<td>Mesh erosion 1/34 (3)</td>
<td>Vaginal irritation with antiseptic wound-dressing</td>
<td></td>
</tr>
<tr>
<td>Dwyer and O’Reilly [32], retrospective study, Australia</td>
<td>97, vaginal prolapse</td>
<td>29</td>
<td>Transvaginal repair of anterior and posterior compartment prolapse with mesh</td>
<td>Atrium polypropylene</td>
<td>ND</td>
<td>Secondary post-operative haemorrhages 2/97 (2), de novo dyspareunia 3/97 (3), de novo urgency and urge incontinence 6/97 (6), de novo constipation 1/97 (1), de novo voiding difficulty 1/97 (1), recto-vaginal fistula 1/97 (1)</td>
<td>Vaginal erosion 9/97 (9)</td>
<td>Surgical closure of the recto-vaginal fistula, administration of oestrogen cream in 3 cases of asymptomatic erosion of the mesh and excision of the mesh in the other 6 cases of symptomatic mesh erosion</td>
<td></td>
</tr>
<tr>
<td>Mercer-Jones et al. [19], retrospective case-series study, UK</td>
<td>22, rectocele</td>
<td>12.5</td>
<td>Transperineal mesh repair</td>
<td>(1) Prolene 14/22 (64), (2) Vipro II 8/22 (36)</td>
<td>Mesh infection 0/22 (0), wound infection with small dehiscence of the subcutaneous sutured layer 1/22 (4.5)</td>
<td>0/30 (0)</td>
<td>Erosion 0/22 (0)</td>
<td>No mesh has been removed</td>
<td>Semi-absorbable mesh repair was superior to non-absorbable mesh repair There were lateral erosions and no suppurations were observed</td>
</tr>
<tr>
<td>Yan et al. [20], prospective study, France</td>
<td>30, cystocele grade II (18) or III (12)</td>
<td>6.7</td>
<td>Placement of a synthetic subsvesical mesh secured anteriorly through the obturator foramen with simultaneous placement of suburethral slings in six of them</td>
<td>(1) Polypropylene 27/30 (90), (2) Polyester 3/30 (10)</td>
<td>Dyspareunia 5/14 (36), de novo stress incontinence 2/30 (7), de novo urge incontinence 3/30 (10), post-operative urinary retention 3/30 (10), rectocele 1/30 (3), polyp 1/30 (3)</td>
<td>Polypropylene anterior vaginal wall erosion 1/27 (4), polyester anterior vaginal wall erosion 1/3 (33)</td>
<td>Excision of the visible graft in the 2 cases of erosion</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 1** (Continued)
<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Study Type</th>
<th>Participants</th>
<th>Primary Intervention</th>
<th>Mesh Material</th>
<th>Complications</th>
<th>Mesh Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vancaillie [33], retrospective study, Australia</td>
<td>31, recurrent vaginal wall prolapse</td>
<td>ND</td>
<td>Repair with MycroMesh in 22 women (group B) or with other materials in 9 women (group A)</td>
<td>(1) Expanded PTFE (MycroMesh) 22/31 (71), (2) Dexon or polypropylene or polyglycan 9/31 (29)</td>
<td>ND</td>
<td>Rejection of MycroMesh in group B 4/22 (18), rejection of other materials in group A 0/9 (0)</td>
</tr>
<tr>
<td>Von Theobald and Labbe [26], retrospective study, France</td>
<td>92, pelvic organ prolapse</td>
<td>ND</td>
<td>Three-way prosthetic repair using a vesico-vaginal mesh for the cystocele, a recto-vaginal mesh for the rectocele and a posterior retro-an trans levatory vault suspension sling</td>
<td>Polypropylene</td>
<td>Hematoma of the pararectal fossa with secondary abscess formation 1/92 (1)</td>
<td>Dyspareunia or dyschesia 3/92 (3)</td>
</tr>
<tr>
<td>De Tayrac et al. [27], retrospective study, France</td>
<td>48, grade III (37/48)-IV (11/48) cystocele</td>
<td>18</td>
<td>Cystocele repair by the vaginal route with a tension-free sub-bladder prosthesis</td>
<td>Polypropylene (GyneMesh TM), Gynecare, Ethicon France</td>
<td>Post-operative infection 0/48 (0)</td>
<td></td>
</tr>
<tr>
<td>Sullivan et al. [34], retrospective study, USA</td>
<td>205/236, pelvic organ prolapse</td>
<td>63.6</td>
<td>Total pelvic mesh repair (TPMR)</td>
<td>Marlex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Choe et al. [46], retrospective study, USA</td>
<td>30, pelvic prolapse and SUI</td>
<td>18</td>
<td>Vaginal reconstruction with the antibacterial mesh sling alone (12/30) and additional prolapse repair (18/30)</td>
<td>Gore-Tex antibacterial</td>
<td>Suprapubic cellulites 4/30 (13.3), vaginitis 1/30 (3.3)</td>
<td>De novo urge incontinence 1/18 (5.5)</td>
</tr>
<tr>
<td>Montironi et al. [28], retrospective study, Italy</td>
<td>35, vaginal prolapse and cystocele</td>
<td>14.6</td>
<td>Combined vaginal and laparoscopic surgical treatment</td>
<td>Polypropylene</td>
<td>0/35 (0)</td>
<td>De novo urinary incontinence 0/35 (0), dyspareunia 0/35 (0)</td>
</tr>
<tr>
<td>Debodinance et al. [47], clinical trial, controlled clinical trial, France</td>
<td>287, SUI and/or vaginal prolapse</td>
<td>49</td>
<td>Mouchel procedure (127/287), small slings (118/287), large slings (11/287), Stamey procedure (8/287),Patch for paravaginal repair (23/287)</td>
<td>(1) Expanded polytetrafluoroethylene (PTFE) 89/287 (31), (2) Cooley knitted polyester 166/287 (58), (3) lyophilized dura mater 32/287 (11)</td>
<td>ND</td>
<td></td>
</tr>
</tbody>
</table>

Downloaded for Roopa Ram (rram@uams.edu) at University of Arkansas for Medical Sciences from ClinicalKey.com by Elsevier on February 05, 2019. For personal use only. No other uses without permission. Copyright ©2019. Elsevier Inc. All rights reserved.
Foreign body reaction refers to a process in which proteins (albumin and fibrinogen) are absorbed initially by the surface of the polymer. This process results in the attraction and stimulation of macrophages, which respond by releasing inflammatory substances and growth factors. Other inflammatory cells (T-lymphocytes, polymorphonuclear cells, eosinophils, plasma cells, and fibroblasts) are then attracted to the surface of the polymer leading to the formation of a granuloma [12]. Absorbable polymers are less frequently associated with foreign body reactions, but non-absorbable polymers are most frequently used in clinical practice [13].

5. Mesh-related infectious complications

5.1. Incidence

The available evidence suggests that mesh-related infections following surgical treatment of female POP occur rarely (0%) [14–20] but can seriously compromise the patient’s health and quality of life. The type, foreign contact surface, and pore size of meshes applied in POP reconstructive surgery may influence the incidence of mesh-related infections. If the pore size of a mesh is <10 μm, then bacteria that have a size of about 1–2 μm can penetrate and colonise meshes whereas immune cells such as macrophages and neutrophils that are >75 μm cannot penetrate and defend against bacterial contamination [21]. Also, the underlying comorbidity of women treated for POP, including immunosuppression due to various causes (e.g. diabetes mellitus, cortisone use) may influence the incidence of mesh-related infections [22].

It should be mentioned that recently a new semiology, with a classification in four types and under-types, are proposed by some authors: type 1 includes defects of healing, type 2 the infection of the graft, type 3 the shrinkage of the mesh, and type 4 includes erosions [23]. The reported frequency of infection after the use of a vaginal polypropylene mesh and for surgical repair of POP is from 0 to 8% [14–20,24–30]. Furthermore, erosion of polypropylene meshes occurs from 0 to 24% after POP repair surgery [14–20,24–34]. It should be emphasized that clinically evident infection is frequently associated with erosion while asymptomatic infection may be the cause of at least an additional proportion of cases with erosion.

Various types of infections have been associated with the use of polypropylene vaginal mesh including retropubic abscess with cutaneous sinus [35], vesico-vaginal fistula [35,36], recto-vaginal fistula [10,32], pelvic abscess [24], perineal necrotizing infection [37], and vertebral osteomyelitis [38–40]. Iglesia et al. reported that multifilament polypropylene meshes (pore size < 10 μm) were at higher risk of infection than monofilament polypropylene meshes (pore size > 75 μm), a difference that was mainly attributed to the difference in the pore sizes of the meshes [21].

### Table 1 (Continued)

<table>
<thead>
<tr>
<th>Reference, type of study</th>
<th>Mean follow-up (in months)</th>
<th>Type of mesh</th>
<th>Surgical technique</th>
<th>Mesh-related infectious complications</th>
<th>Other complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flood et al. [29], retrospective study, Canada</td>
<td>38.4</td>
<td>Marlex</td>
<td>Modified anterior colporrhaphy reinforced with Marlex mesh</td>
<td>Reaction or persistent infection 0/142 (0)</td>
<td>Dyspareunia 5/142 (3.5), Stress incontinence 1/142 (1), Urinary tract infection 21/142 (15)</td>
</tr>
<tr>
<td>Julian [30], case-control study, USA</td>
<td>24</td>
<td>Marlex</td>
<td>Transvaginal repair with (12/24) or without synthetic mesh (12/24)</td>
<td>Granulation tissue over the graft causing spotting 3/12 (25), 0.5 cm opening below the graft that caused abnormal discharge 3/12 (25)</td>
<td>Vaginal erosion 1/12 (8), Primary closure against medical advice for partial removal of the graft, silver nitrate cautery of the granulation tissue, trimming of the eroded graft</td>
</tr>
</tbody>
</table>

* Incidence of new onset of dyspareunia (sexually inactive patients excluded).

Downloaded for Roopa Ram (rram@uams.edu) at University of Arkansas for Medical Services from ClinicalKey.com by Elsevier on February 05, 2019. For personal use only. No other uses without permission. Copyright ©2019. Elsevier Inc. All rights reserved.
should be mentioned that several studies did not report any patients with infection or erosion with application of polypropylene meshes in female pelvic organ prolapse surgery (see Table 1).

It is interesting that Milani et al. proposed that use of prolene mesh should be abandoned because of the morbidity associated mainly with non-infectious complications (6.5–13% erosion) in their prospective study of 63 women with anterior or/and posterior vaginal wall prolapse [24]. On the other hand, several authors [27,29,41] proposed that the use of polypropylene mesh in pelvic surgery is effective and safe, with minimal infectious and/or non-infectious complications.

Data regarding the incidence of mesh-related infections with use of knitted polyester and silicone or silicone-coated meshes, revealed a high rate of erosion (0–33% with use of polyester meshes, 19% with use of silicone meshes), rejection (19% with Dacron), and infection (0% for Vypro II, 5% for silicone mesh) [20,42]. Thus, several surgical teams have abandoned use of silicone-coated vaginal meshes [42]. However, the experience of Rozet et al. with 363 women treated with laparoscopic sacral colpopexy with use of 100% polyester mesh, suggested acceptable mesh infection rates (0.8%) [43]. Furthermore, use of polyethylene (Mersilene) slings was associated with persistent discharging sinus in 7.1% of 28 patients [44], 7.5% wound infections [45], and 15% urinary tract infections [45], data which question the use of polyethylene in current pelvic organ prolapse surgery.

Erosion rates from 0 to 30% were reported with the use of polytetrafluoroethylene (PTFE) in pelvic prolapse surgery [33,46,47]. According to Mattox et al., these erosions were a clinical manifestation of mesh-related infections [48]. According to Debodinance et al., expanded-PTFE (Gore-Tex) meshes were associated with rejection, removal, and sinus tract formation in 30, 35, and 10% of patients, respectively [47]. Choe et al. in a prospective study of 30 women with urinary incontinence and/or vaginal prolapse had good short-term results with the use of expanded-PTFE antibacterial mesh sling (Gore-Tex, 3% vaginitis and 0% erosions) [46]. However, Vancaillie reported mesh rejection in 18% of women with recurrent vaginal wall prolapse managed with surgery with the use of PTFE-mesh (MycronMesh) [33].

A few data exist concerning semi-absorbable mesh-related infections. Nicita et al., in a prospective study of 23 women with transvaginal repair of total genitourinary prolapse with synthetic mesh of mixed polypropylene and 910 polyglactin fibers, did not report any cases of infection or erosion of mesh [17]. Furthermore, Mercer-Jones et al. in a case series study of transperineal mesh repair of rectocoele reported that semi-absorbable mesh repair was superior to non-absorbable mesh repair [19].

The available data suggest that the surgical technique that is employed for the repair of POP influences the probability of development of a vaginal mesh-related infection. For example, Visco et al. [49] and Culligan et al. [50] suggested that the observed incidence of mesh infection or/and erosion was higher when the mesh was introduced vaginally as compared to the abdominal approach during sacral colpopexy procedures. Some studies have shown a higher incidence of erosion when concomitant hysterectomy was performed during sacral colpexies [51]. However, Brizzolara and Pillai-Allen [41] did not find significant differences regarding development of mesh-related infection depending on whether colpexy was done or not after hysterectomy. Furthermore, Mattox et al. suggested that the application of braided permanent sutures to affix the graft to the vagina may be associated with mesh infections [48].

There are no comparative studies regarding the incidence of development of infection after the use of a mesh in abdominal hernia surgery and a vaginal mesh in POP surgery [12]. Thus, no definitive statements can be made whether the vaginal surgical route is associated with increased infectious complications or whether the incidence of mesh-related infections is mainly associated with the type of procedure, the preventive measures taken, and patient characteristics including age and comorbidity factors.

5.2. Clinical manifestations

The usual initial complaints in patients with development of a mesh-related infectious complication after POP surgery include a combination of the following: non-specific pelvic pain, persistent vaginal discharge or bleeding, dyspareunia, and urinary or faecal incontinence. Severe low back pain may occur years after abdominal sacral colpopexy as an unusual complication of sacral abscesses [38]. Clinical examination can reveal induration of the vaginal incision, vaginal granulation tissue, draining sinus tracts, and prosthesis erosion or rejection. A mesh-related infection can sometimes manifest as a pelvic abscess in the retropubic space, pararectal abscess, ischio-rectal abscess, vesicovaginal fistula, recto-vaginal fistula, abdominal fistula, sigmoid bowel-vaginal fistula, entero-cutaneous or entero-perineal fistulas, and osteomyelitis.

5.3. Microbiology

Normal vaginal bacterial flora consists of a variety of microorganisms such as Lactobacillus coryneforms, anaerobic bacteria, Staphylococcus spp., Streptococcus spp., Enterococcus faecalis, Escherichia coli, and Klebsiella pneumonia [52]. Usual causative organisms associated with vaginal mesh infections are Gram-positive, Gram-negative, anaerobic bacteria, or/and fungal microorganisms. Bent et al. reported that histologic evaluation of rejected PTFE interstices, revealed Gram-positive cocci [53]. However, microbiological analysis of perigraft tissues of Dacron after erosion, showed a few Morganella morganii and E. coli colonies [54]. Cases of Actinomycesis presenting as recurrent vaginal erosions of tension-free vaginal tapes (TVT) have been also described.
Furthermore, Cranney et al., reported a patient with polymicrobial osteomyelitis possibly attributed to an infected mesh subsequent to sacroscopy [39]. We also reported a patient with vaginal mesh-related infection due to *Bacteroides melaninogenicus* [55].

5.4. Prevention

A crucial point regarding prevention of vaginal mesh-related infections is the relationship between foreign body reactions and amount of the material used. Meshes, with pore size diameter greater than 75 μm, which permits polymorphonuclear leukocytes, macrophages, and fibroblasts to penetrate the mesh in case of infection, theoretically could be associated with reduced incidence of mesh-related infections after female POP surgery compared to the use of vaginal mesh with small pores (<10 μm). New generation lighter and softer monofilament polypropylene meshes specially designed for use in vaginal surgery have been proposed recently (Gynemesh soft) (TM) with the aim to minimizing the amount of implanted material and therefore the incidence of infectious complications and tissue reaction [56].

Furthermore, it should be mentioned that certain precautions and measures are necessary to minimize infection by the use of vaginal meshes. For this reason, meticulous antisepsis of the perineum, vulva, and vagina with a sponge soaked in a surgical soap or a povidone–iodine solution are proposed as a routine in the operating room before starting the surgical procedure. Covering of the anus and the perineum are necessary. Opening the mesh and embedding within an antiseptic solution just before the insertion, along with change of gloves before handling the graft have been proposed. Gentle handling of tissue, dissection in avascular spaces, and adequate haemostasis are essential [55].

Dissection between pelvic fascia and the pelvic organs allow deep placement of the mesh and minimizes vaginal erosion. Mesh should be placed in a tension-free manner and removal of the excessive vaginal wall should be avoided in order to reduce the probability of post-operative pelvic pain and dyspareunia [54]. Concomitant vaginal hysterectomy especially when an inverted ‘T’ incision was performed was associated with increased risk of graft erosion [36].

During POP surgery, the wound can be intermittently rinsed with an antibiotic-containing solution until operation finish. An animal model [57] showed that this approach consistently inhibits bacterial adhesion to the surface of the mesh, as well as their growth. However, a limitation of such preventive approaches regarding mesh-related infections may be the fact that antibiotics usually require a defined duration of contact with pathogens, while lavage is a more rapid process.

A strategy to try to reduce the possibility of development of infection is the use of a mesh embedded with antimicrobial agents. Such a mesh may prevent bacterial adhesion and colonisation with likely subsequent reduction of intra-operative and post-operative infections. According to Choe et al., expanded-PTFE antibacterial mesh sling (Gore-Tex) seems to be an excellent choice with very low infection or/and erosion rates [46]. However, some different types of meshes such as PTFE-mesh (Mycro-Mesh) embedded to antimicrobial agents had rejection rate of 18% [33]. Further published experience is needed for the evaluation of the outcomes, including infectious complications, of POP surgical reconstruction using antibacterial meshes.

Traditional intravenous peri-operative administration of antimicrobial agents seems to be beneficial when artificial materials are involved in pelvic organ prolapse surgery. Given that staphylococcal species are involved in a considerable proportion of cases of foreign body related infections, including mesh-related infections, the spectrum of the used peri-operative antimicrobial agent should include these bacteria.

There are no data regarding the need for administration of preventive antimicrobial agents in women with history of POP surgery with the use a vaginal mesh when undergoing dental or other surgical intervention. Gomelsky and Dmochowski [58] suggested that antibiotic prophylaxis may be considered for dental extractions as a preventive measure of mesh-related infectious complications in immunosuppressed women who underwent POP reconstructive surgery.

Although all the above preventive measures seem to reduce mesh-related infectious rates, no definitive recommendation can be made until further comparative outcomes become available.

5.5. Diagnosis and treatment

All clinicians should consider the various manifestations of mesh-related infections including a variety of symptoms and signs of local pelvic inflammation, fever of unknown aetiology, or/and other uncommon clinical manifestations such as a vesico-vaginal fistula, recto-vaginal fistula, pelvic abscess, sigmoid bowel-vaginal fistula, and osteomyelitis in women after POP repair surgery. Pelvic examination remains crucial for early diagnosis of such complications. Erosion of vaginal meshes through the vaginal wall is an evident complication. Intravaginal visualization of a foreign body at apex or elsewhere implies intravaginal mesh erosion or/and infection. Furthermore, eroded meshes through the vagina may indicate a simultaneous infection, based not only on the presence of vaginal discharge or consolidation of inflammatory tissue around the mesh but also on the type of mesh applied [48]. In fact, Mattox et al. report that eroding polytetrafluoroethylene grafts should be considered infected since the human body does not incorporate them during healing process, whereas polypropylene grafts eroding the vagina and had adherent scar tissue preventing higher dissection may denote erosion without infection [48].
Invasive or non-invasive imaging techniques may be useful for the diagnosis of mesh-related infections. For example, a diagnosis of recto-vaginal erosion after transvaginal repair of the posterior compartment prolapse may be performed with proctoscopy that may reveal mesh protrusion through rectal mucosa [35]. Furthermore, bladder ultrasonography and cystourethroscopy may diagnose possible bladder and urethral erosion in patients presenting with post-operative irritative urinary symptoms [15].

In addition, microbiological studies of partially or totally removed vaginal meshes (due to various symptoms or complications), may provide valuable diagnostic information regarding the management of mesh-related infections after female POP surgery.

Treatment of mesh-related infections in women who underwent pelvic organ reconstruction is combined surgical and medical approach. Medical management includes the application of topical estrogen cream, administration of intravenous or oral antibiotics [11]. The use of local estrogen cream could help in managing conservatively possible graft erosion after infection has been treated effectively.

Surgical treatment of vaginal mesh-related infections in female pelvic surgery, implies drainage of possible abscesses and a partial or total, transvaginal or abdominal, removal of the vaginal mesh. It is important to avoid performing a diagnostic paracentesis of mesh-related seromas [59], when there are no symptoms and/or signs of inflammation. Such a procedure could transform an aseptic reaction into an infectious process. The type of mesh implanted may influence the preferred surgical method of mesh removal. Meshes that might not integrate with local tissues during the healing process and are encapsulated, usually require total removal when are infected. Such a removal of a totally infected graft is usually not technically difficult. Macroporous monofilament meshes that integrate well with vaginal tissues could be managed with partial removal or even more conservative approach such as antibiotics, local antiseptics, and possibly local estrogen therapy in post-menopausal women with vaginal atrophy.

For example, based on the experience of Govier et al. [42], a complete transabdominal removal of silicone meshes was needed to eradicate sources of infection. However, Mattox et al. report that the preferred way of treatment of eroded meshes is the transvaginal approach, although there is continuing controversy in the scientific community, on how to treat an infected vaginal mesh [48].

6. Conclusion

The use of vaginal meshes in POP repair has been an advance in the management of women with this condition. However, clinicians and patients should be aware of the various mesh-related infectious and non-infectious complications that may develop after this operation. Specifically, regarding the infectious complications, clinicians should have in mind the types of the used vaginal meshes as well as the clinical manifestations and the usual causative microorganisms of vaginal mesh infections.

Late complications have been reported and most of the studies included in this review report only the short and medium term results. Independently of the surgical approach followed, a longer follow-up, for at least 2 years [9], of women undergoing mesh-assisted surgical repair of pelvic organ prolapse, may help in the early identification of late manifestations of mesh-related infections. Larger studies with longer follow-up will help further assess the overall risk of infectious and non-infectious complications related to the use of vaginal meshes in pelvic reconstructive surgery.

Conflict of interest

None.

References


For personal use only. No other uses without permission. Copyright ©2019. Elsevier Inc. All rights reserved.


