



Tobacco use, immunosuppressive, chronic pain, and psychiatric conditions are prevalent in women with symptomatic mesh complications undergoing mesh removal surgery

Elliot K. Blau¹ , Sarah A. Adelstein² , Katherine A. Amin¹ , Sharon J. Durfy¹ , Alvaro Lucioni¹ , Kathleen C. Kobashi¹ , Una J. Lee¹

¹Section of Urology and Renal Transplantation, Virginia Mason Medical Center, Seattle, WA, ²Department of Urology, Rush University Medical Center, Chicago, IL, USA

Purpose: To identify demographic and clinical characteristics of patients with symptomatic pelvic floor mesh complications who underwent mesh removal at our academic medical center. The secondary goal was to determine patient-reported outcomes after mesh removal.

Materials and Methods: We conducted a retrospective review of consecutive patients from 2011–2016 undergoing removal of mesh graft for treatment of symptomatic mesh-related complications. Patient demographics, comorbidities, symptoms, and mesh factors were evaluated. Outcomes after explant were determined by the Patient Global Impression of Improvement and a Likert satisfaction scale.

Results: One hundred fifty-six symptomatic patients underwent complete or partial pelvic floor mesh removal during the study period. Mid-urethral slings comprised 86% of explanted mesh grafts. Mesh exposure or erosion was identified in 72% of patients. Eighty-one percent of patients presented with pain, and 35% reported pain in the absence of exposure or erosion. Pre-operative comorbidities included psychiatric disease (54.5%), chronic pain (34.0%), irritable bowel syndrome (20.5%) and fibromyalgia (9.6%). Forty-three percent of patients reported current or past tobacco use. At mean follow-up of 14 months, 68% of responding patients reported improvement on the Patient Global Impression of Improvement after surgery.

Conclusions: This research identified tobacco use, and psychiatric, immunosuppressive, and chronic pain conditions as prevalent in this cohort of patients undergoing mesh removal. Surgical removal can improve presenting symptoms, including for patients with pain in the absence of other indications.

Keywords: Pain; Pelvic organ prolapse; Suburethral slings; Urinary incontinence; Urologic surgical procedures

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/4.0>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

INTRODUCTION

Stress urinary incontinence (SUI) and pelvic organ pro-

lapse (POP) are common pelvic floor disorders affecting women of all ages. Approximately 11% of women will seek surgical correction of their incontinence and/or prolapse in

Received: 26 June, 2019 • **Accepted:** 13 October, 2019

Corresponding Author: Una J. Lee <https://orcid.org/0000-0003-1128-5083>

Section of Urology and Renal Transplantation, Virginia Mason Medical Center, 1100 9th Ave, C7-URO, Seattle, WA 98101, USA
TEL: +1-206-223-6772, FAX: +1-206-223-7650, E-mail: Una.Lee@virginiamason.org

their lifetime [1]. Polypropylene mesh mid-urethral slings (MUS) were approved by the U. S. Food and Drug Administration (FDA) in 1998. These thin strips of mesh revolutionized treatment of SUI for women by providing a minimally invasive, durable, effective surgical treatment for SUI [2,3].

In the mid-2000s, polypropylene mesh began to be used for vaginal POP surgery, to augment transvaginal repairs in a manner similar to inguinal herniorrhaphy. Sheets of mesh have also been utilized abdominally for sacrocolpopexy for POP since well before MUS surgery developed wide acceptance. However, complication rates of POP repairs with transvaginal mesh (TVM) were higher than expected, prompting the FDA to issue a public health notification in 2008 and an update in 2011 [4,5]. The FDA emphasized the need for a more rigorous informed consent process to educate and inform patients of the full range of potential and serious complications associated with the surgical use of polypropylene mesh in this setting, including erosion, pain, infection, bleeding, organ perforation, dyspareunia and urinary issues [4-6]. Complications after MUS have also been identified and include vaginal mesh exposure, mesh erosion into the bladder or urethra, pelvic pain, groin pain, and dyspareunia [7,8]. Mesh complications after sacrocolpopexy have also been reported, including mesh erosion into the bladder, bowel, or vagina, dyspareunia, and pelvic pain [9-12].

There is limited literature on preoperative factors which may predispose patients to mesh complications specifically, as opposed to complications from surgery in general [7]. Similarly, there are limited data regarding the outcomes of women undergoing mesh explant due to mesh complications [13]. Here, we present data from our tertiary referral center experience of pelvic floor mesh explant surgery for symptomatic mesh complications. The primary goal of this study was to characterize the clinical and demographic features of patients in our clinical population with symptomatic mesh complications and secondarily, to describe outcomes after mesh removal in this population.

MATERIALS AND METHODS

This is an institutional review board (IRB)-approved, retrospective case series of consecutive female patients undergoing partial or complete removal of synthetic mesh graft for POP and/or SUI for the treatment of symptomatic, mesh-related complications, performed at a single-site tertiary referral center by 3 fellowship-trained female pelvic medicine and reconstructive surgery (FPMRS) urologists (Benaroya Research Institute at Virginia Mason IRB, approval number: 3011200). Informed consent was waived for this study. Mesh

explant surgeries were performed between January 2011 and December 2016 and were identified by Current Procedural Terminology (CPT) codes 57287 (removal or revision of sling for stress incontinence), 57295 (removal or revision of vaginal mesh, vaginal approach) and 57296 (removal or revision of prosthetic vaginal graft, abdominal approach). The decision for partial versus complete mesh graft removal was discretionary based on both surgical and patient considerations, and detailed pre-operative counseling between the surgeon and patient. Patients with mesh complications who were asymptomatic and managed conservatively without surgical excision were not included in the study.

Index surgeries included MUS for anti-incontinence, TVM and/or sacrocolpopexy for POP repair, and included any combination of these surgeries. MUS type was further defined as retropubic, transobturator, single-incision, or bone anchored. Index surgeries were not required to be performed at the study institution. Original operative notes were obtained whenever possible. Patient demographics, comorbidities, presenting symptoms, exam findings, mesh characteristics, and surgical factors were obtained via chart review of the electronic medical record, and primary care and specialty clinic records were reviewed when possible to confirm diagnoses. Comorbidities were defined as conditions determined to be present prior to placement of mesh. Psychiatric comorbidities included depression, anxiety and/or bipolar disorder. Chronic pain conditions preexisting prior to mesh placement were recorded, including chronic neck and/or back pain, migraines, chronic pelvic pain, fibromyalgia, and endometriosis. Chronic obstructive pulmonary disease, diabetes, and rheumatologic/autoimmune diseases were identified. When available, pre-operative visual analogue scale (VAS) for pain (0–10) was collected prior to explant surgery. The International Urogynecological Association (IUGA) Complication grades were determined pre-operatively from review of the medical record for all patients reporting pain related to their mesh [14].

Patient-reported outcome measures including the Patient Global Impression of Improvement (PGI-I) and Likert satisfaction scale (0–10), were collected postoperatively via questionnaires mailed 6 and 12 months after surgery and annually thereafter. When more than 1 questionnaire was returned, the first questionnaire returned was included in the analysis. Measures were summarized using means and frequencies, and 95% confidence intervals (CIs) where appropriate. Descriptive statistics were performed using R version 3.5.1 (<https://www.R-project.org>).

RESULTS

A total of 156 women underwent surgical removal of mesh graft for treatment of symptomatic complications during the 5 year study period. All initial mesh implants were placed between 1990 and 2015. Table 1 summarizes the pre-

Table 1. Patient comorbidities at time of index mesh implant surgery (n=156)

Comorbidities	Value
Psychiatric	85 (54.5)
Chronic pain	53 (34.0)
Irritable bowel syndrome	32 (20.5)
Rheumatologic/autoimmune	23 (14.7)
Diabetes	22 (14.1)
Endometriosis	19 (12.2)
Fibromyalgia	15 (9.6)
Chronic obstructive pulmonary disease	14 (9.0)
None	23 (14.7)

Values are presented as number (%).

Table 2. Patient characteristics and presenting symptoms prior to mesh removal or revision (n=156)

Characteristic	Value
Age (y)	57.0±12.4
BMI (kg/m ²)	29.3±6.6
Parity (median)	2.0
Tobacco	
Current use	37 (23.7)
Past use	30 (19.2)
Prior mesh revision surgery	75 (48.1)
One	39 (25.0)
Two or more	9 (5.8)
Pain	127 (81.4)
Dyspareunia	83 (53.2)
Vaginal	54 (34.6)
Suprapubic	37 (23.7)
Groin	14 (9.0)
Urethra	12 (7.7)
Pelvic, not otherwise specified	7 (4.5)
Mesh exposure	
Vagina	78 (50.0)
Mesh erosion	
Urethra	17 (10.9)
Bladder	11 (7.1)
Urethra and bladder	2 (1.3)
Bowel	1 (0.6)
Obstructive voiding	53 (34.0)
Infections, urinary	44 (28.2)

Values are presented as mean±standard deviation, number only, or number (%).

operative comorbidities of this cohort at time of the initial surgery. Psychiatric diagnoses were prevalent 85 (54.5%) patients, depression and anxiety co-occurred in 21 (13.5%), depression alone was recorded in 42 (26.9%), and anxiety alone in 17 (10.9%). Bipolar disorder was observed in 3 patients. Chronic pain conditions were observed in 53 (34.0%) patients, though no patient had chronic pelvic pain prior to the mesh implant surgery. Autoimmune and rheumatologic disorders were seen in 23 (14.7%) patients and included diagnoses of rheumatoid arthritis, systemic lupus erythematosus, psoriasis, Sjogren’s syndrome, Raynaud’s disease and/or thyroiditis.

Demographic characteristics and patients’ presenting symptoms at the time of mesh removal are shown in Table 2. The primary indication for removal of mesh was pain, reported in 127 women (81.4%) and 92 (59.0%) women with pain described 2 or more sites/sources of pain. The severity of pain measured by the IUGA/International Continence Society (ICS) Grades of Pain Subclassification Scale ranged from “provoked pain only (during vaginal exam)” to “spontaneous pain”, Fig. 1. A total of 78 (50.0%) women presented with a vaginal mesh exposure and 31 (19.9%) presented with mesh erosion into the bladder, urethra, and/or bowel. Three women presented with concomitant visceral erosion and vaginal exposure. There were 2 cases of erosion of mesh into both the bladder and urethra and 1 case of mesh erosion into bowel. Pain co-occurred with a mesh exposure or erosion 64.7% of the time (101/156). Thirty-five percent (54/156) of women presented with pain localized to their mesh implant and no evidence of exposed mesh in the vagina and no erosion within the bladder or urethra. *De novo* urinary tract infections (defined as 2 or more annual infections beginning

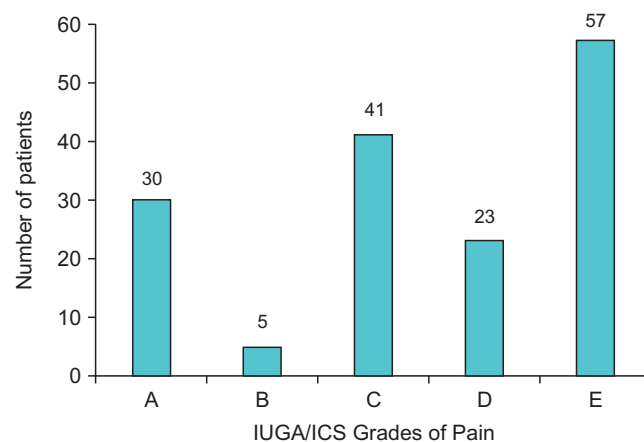


Fig. 1. International Urogynecological Association (IUGA)/International Continence Society (ICS) Grades of Pain Subclassification Scale, based on pre-operative assessment. A, asymptomatic or no pain; B, provoked pain only (during vaginal examination); C, pain during sexual intercourse; D, pain during physical activities; E, spontaneous pain.

Table 3. Surgical characteristics of mesh removal or revision procedures (n=156)

Characteristic	Value
Time to explant (mo)	63.5 (30.4–89.8) [0.9, 317.7]
Mesh type	
Transvaginal mesh	38 (24.4)
Sacrococpopexy	13 (8.3)
Multiple	31 (19.9)
Sling	126 (80.8)
Sling type	
Retropubic	21 (13.5)
Transobturator	23 (14.7)
Single-incision	2 (1.3)
Bone anchor	3 (1.9)
Not available	77 (49.4)
Surgical approach	
Vaginal	131 (84.0)
Vaginal and retropubic	7 (4.5)
Abdominal	8 (5.1)
Urinary diversion	1 (0.6)

Values are presented as median (interquartile range) [minimum, maximum] or number (%).

after placement of mesh) occurred as a presenting symptom for 44 (28.2%) of women.

Patient mesh implant characteristics and the surgical approaches utilized for removal are presented in Table 3. Median time from index surgery to mesh explant was 63.5 months (interquartile range [IQR], 30.4–89.8 months). One patient ultimately required urinary diversion for obliteration of the bladder outlet and persistent ureterovaginal fistula, having failed prior conservative surgical management of her MUS complication.

Median preoperative VAS pain score was available for 123 patients (78.8%) and was 5/10 (IQR, 0–7). Forty-two percent of patients returned at least 1 post-surgery questionnaire, with a mean follow-up of 14 months. For these patients, the mean Likert satisfaction score after mesh removal was 7.4/10±3.0. Responses to the PGI-I showed that 68% of these patients reported feeling a little better, better, or very much better after surgery (mean, 2.9±1.68).

DISCUSSION

Developing a deeper understanding of why mesh complications occur in some women but not in others is a critical issue for female pelvic medicine. Risk factors associated with complications are challenging to study, in part because the development of mesh complications in women is multifactorial. The heterogeneity of patient characteristics and

surgical factors, limited sample sizes, as well as the lack of a matched control group of women without mesh complications are challenges that occur with research in this area. Additionally, assessment of risk factors for mesh implant complications can be challenging due to the relatively low frequency of mesh complications and the variable length of time to presentation of these issues. In this study, we identified several demographic and clinical characteristics and comorbidities in a tertiary patient population undergoing mesh explant surgery for symptomatic mesh complications. These included psychiatric comorbidities, chronic pain, rheumatologic or autoimmune disease, diabetes, irritable bowel syndrome, tobacco use, and having a prior revision.

Previous research has suggested possible risk factors for mesh complications, including hypertension, diabetes, fibromyalgia, tobacco use, and concomitant hysterectomy [15–17]. One study investigating common comorbidities among urogynecologic patients showed a high prevalence of obesity, hypertension, coronary artery disease, and diabetes mellitus, conditions which may increase overall risk of adverse surgical outcomes [18]. Similar to our findings, Danford et al. [16] identified tobacco use as frequently present in patients who undergo surgical excision for mesh complications. Another study showed that tobacco use was associated with a three-fold increase in the risk of developing a vaginal erosion after TVM repair of POP [19].

The American Urological Association (AUA) 2017 guidelines on the surgical management of SUI address some of the potential risk factors associated with mesh sling surgery, specifically in Guidelines 19 and 22 which discuss special populations and circumstances [20]. Guideline 19 indicates that chronic states such as systemic autoimmune disorders may lead to impaired wound healing and thereby increase the risk for mesh complications. Guideline 22 notes that diabetic, obese, and/or geriatric patients should be counseled regarding a higher risk of mesh erosion and potential for reduced clinical effectiveness, compared with patients without these conditions. Our results support the importance of these recommendations, as our cohort included 40 patients (25.6%) with rheumatologic and autoimmune disorders and/or diabetes. Our results also raise questions about whether women with immunosuppressive and chronic inflammatory disorders may be at greater risk for complications from mesh implants.

Chronic neck or back pain and migraines predating their mesh surgery were present in 34% of our cohort. Evidence that chronic pain disorders may contribute to mesh-related complications in POP surgery is increasing, although differences in definitions of chronic pain make direct comparisons

between studies challenging [21,22]. Another observation was that 53% of the patients in this study had a history of psychiatric disorders prior to their initial surgery, including depression, anxiety, and/or bipolar disorder. Previous literature has thoroughly examined the complex relationship between depression and pain [23,24]. Other evidence supports an association between psychiatric disorders, such as depression and anxiety, and post-operative complications [25-27]. Currently, the association of mental health conditions with symptomatology related to pelvic floor surgeries is not well understood. Depression has been associated with pelvic floor disorders in women, however as Larouche et al. [28] note, study methodologies and prevalence reported vary considerably. A recent report identified an increased risk of depression for women younger than 46 years after receiving a mesh surgical revision compared with women not requiring a revision, although women with a previous history of depression were excluded from these analyses [29]. To the best of our knowledge, our observation of increased prevalence of anxiety, depression, and/or bipolar disorder prior to index surgery in women who undergo mesh explant for symptomatic relief has not been previously reported. A deeper understanding of the interplay of mental health conditions such as anxiety, depression, and bipolar disorder with pain in pelvic floor disorders is needed.

A secondary goal of our study was to describe patient-reported outcomes associated with mesh removal in symptomatic patients. Most women undergoing mesh removal in this cohort presented with pain. However, it is important to note that 35% of women in this cohort experienced pain in the absence of mesh exposure or erosion. This may be explained by the histopathologic findings and inflammatory response that have been observed with the use of transvaginal polypropylene mesh, which may invoke pain without clinical evidence of obstruction or erosion [30-32]. Prior studies have shown that 60% to 80% of women have relief of pain after mesh removal (TVM and/or sling mesh) [15,22], and our results are consistent with these reports. Rogo-Gupta et al. [33] examined a cohort of 179 of 306 women who underwent removal of TVM and completed a follow-up questionnaire. Of 81 women providing PGH scores, 64 patients (78%) reported that their symptoms were improved overall reiterating the role for surgical excision in properly identified and counseled patients.

This retrospective study has several limitations. The patient cohort represents a single-institution and practice patterns may vary across different institutions and regions of the US and internationally. Surgeries were performed by 3 fellowship-trained FPMRS urologic surgeons located at a ter-

tiary referral center. This referral pattern may impact the characteristics and/or complexity of patients who presented. Original operative notes for index mesh implant surgeries were obtained whenever possible, but were not always available. Pre-operative VAS pain scores were obtained as available, and post-operative VAS pain scores were not collected. The post-operative outcome data was patient-reported, and subjective in nature. Additionally, the patient population was heterogeneous and all types of mesh excision surgeries were included in this series (ie, sling, TVM, and abdominal/robotic sacrocolpopexy). We acknowledge that correlations or associations cannot be established from this descriptive, clinically-based case series, but these observations may provide data for further hypothesis-driven investigation.

This study examines complications related to the use of polypropylene mesh in female pelvic floor surgery which is a timely and critically important issue. Information on mesh-related complications is important to further our understanding, to potentially identify risk factors, and to prevent future complications that are specific to the use of mesh in pelvic floor reconstruction. This study has several strengths, including the large, consecutive series of patients at a tertiary referral center. Post-operative outcomes described in this study are consistent with prior series examining surgically managed mesh complications. Further, this study examines the impact and site(s) of patients' pain with the IUGA/ICS Grades of Pain Subclassification Scale. Finally, this study provides real-world clinical data reflecting patient and surgical characteristics, including pre-operative patient-specific comorbidities and presenting symptoms together with follow-up data following mesh removal.

CONCLUSIONS

The use of polypropylene mesh for SUI and/or POP is associated with potential complications ranging in severity from minor to devastating. This research identified tobacco use, and psychiatric, immunosuppressive, and chronic pain conditions as prevalent in this cohort of patients undergoing mesh removal. Surgical removal can improve presenting symptoms, including for patients with pain in the absence of other indications, underlining the importance of counseling patients with symptomatic complications about this option.

CONFLICTS OF INTEREST

The authors have nothing to disclose.

ACKNOWLEDGMENTS

The authors thank Deborah Sparks, CCRC, for assistance with data collection and Virginia M. Green, PhD for manuscript preparation.

AUTHORS' CONTRIBUTIONS

Research conception and design: Elliot K. Blau, Sarah A. Adelstein, Katherine A. Amin, Alvaro Lucioni, Kathleen C. Kobashi, and Una J. Lee. Data acquisition: Elliot K. Blau, Sarah A. Adelstein, and Una J. Lee. Statistical analysis: Elliot K. Blau, Sarah A. Adelstein, and Una J. Lee. Data analysis and interpretation: Elliot K. Blau, Sarah A. Adelstein, Sharon J. Durfy, and Una J. Lee. Drafting of the manuscript: Elliot K. Blau, Sarah A. Adelstein, Katherine A. Amin, Sharon J. Durfy, and Una J. Lee. Critical revision of the manuscript: Elliot K. Blau, Sarah A. Adelstein, Katherine A. Amin, Sharon J. Durfy, Alvaro Lucioni, Kathleen C. Kobashi, and Una J. Lee. Administrative, technical, or material support: Elliot K. Blau, Sarah A. Adelstein, Katherine A. Amin, and Sharon J. Durfy. Supervision: Alvaro Lucioni, Kathleen C. Kobashi, and Una J. Lee. Approval of the final manuscript: all authors.

REFERENCES

- Olsen AL, Smith VJ, Bergstrom JO, Colling JC, Clark AL. Epidemiology of surgically managed pelvic organ prolapse and urinary incontinence. *Obstet Gynecol* 1997;89:501-6.
- Jonsson Funk M, Siddiqui NY, Kawasaki A, Wu JM. Long-term outcomes after stress urinary incontinence surgery. *Obstet Gynecol* 2012;120:83-90.
- Nager C, Tulikangas P, Miller D, Rovner E, Goldman H. Position statement on mesh midurethral slings for stress urinary incontinence. *Female Pelvic Med Reconstr Surg* 2014;20:123-5.
- Stanford E, Moen M. Patient safety communication from the Food and Drug Administration regarding transvaginal mesh for pelvic organ prolapse surgery. *J Minim Invasive Gynecol* 2011;18:689-91.
- Menchen LC, Wein AJ, Smith AL. An appraisal of the Food and Drug Administration warning on urogynecologic surgical mesh. *Curr Urol Rep* 2012;13:231-9.
- Barski D, Otto T, Gerullis H. Systematic review and classification of complications after anterior, posterior, apical, and total vaginal mesh implantation for prolapse repair. *Surg Technol Int* 2014;24:217-24.
- Kirby AC, Nager CW. Indications, contraindications, and complications of mesh in the surgical treatment of urinary incontinence. *Clin Obstet Gynecol* 2013;56:257-75.
- Marks BK, Goldman HB. Controversies in the management of mesh-based complications: a urology perspective. *Urol Clin North Am* 2012;39:419-28.
- Nygaard I, Brubaker L, Zyczynski HM, Cundiff G, Richter H, Gantz M, et al. Long-term outcomes following abdominal sacrocolpopexy for pelvic organ prolapse. *JAMA* 2013;309:2016-24.
- Paine M, Harnsberger JR, Whiteside JL. Transrectal mesh erosion remote from sacrocolpopexy: management and comment. *Am J Obstet Gynecol* 2010;203:e11-3.
- Sarlos D, Aigmueller T, Schaer G. A technique of laparoscopic mesh excision from the bladder after sacrocolpopexy. *Am J Obstet Gynecol* 2015;212:403.e1-3.
- Takacs EB, Kreder KJ. Sacrocolpopexy: surgical technique, outcomes, and complications. *Curr Urol Rep* 2016;17:90.
- Ulrich D, Bjelic-Radicic V, Höllein A, Trutnovsky G, Tamussino K, Aigmüller T. Quality of life and objective outcome assessment in women with tape division after surgery for stress urinary incontinence. *PLoS One* 2017;12:e0174628.
- Haylen BT, Freeman RM, Swift SE, Cosson M, Davila GW, Deprest J, et al.; International Urogynecological Association; International Continence Society, Joint IUGA/ICS Working Group on Complications Terminology. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint terminology and classification of the complications related directly to the insertion of prostheses (meshes, implants, tapes) and grafts in female pelvic floor surgery. *Neurourol Urodyn* 2011;30:2-12.
- Hou JC, Alhalabi F, Lemack GE, Zimmern PE. Outcome of transvaginal mesh and tape removed for pain only. *J Urol* 2014;192:856-60.
- Danford JM, Osborn DJ, Reynolds WS, Biller DH, Dmochowski RR. Postoperative pain outcomes after transvaginal mesh revision. *Int Urogynecol J* 2015;26:65-9.
- Geller EJ, Babb E, Nackley AG, Zolnoun D. Incidence and risk factors for pelvic pain after mesh implant surgery for the treatment of pelvic floor disorders. *J Minim Invasive Gynecol* 2017;24:67-73.
- Rechberger T, Nowakowski Ł, Rechberger E, Ziętek A, Winkler I, Miotła P. Prevalence of common comorbidities among urogynaecological patients. *Ginekol Pol* 2016;87:342-6.
- Araco F, Gravante G, Sorge R, De Vita D, Piccione E. Risk evaluation of smoking and age on the occurrence of postoperative erosions after transvaginal mesh repair for pelvic organ prolapses. *Int Urogynecol J Pelvic Floor Dysfunct* 2008;19:473-9.
- Kobashi KC, Albo ME, Dmochowski RR, Ginsberg DA, Goldman HB, Gomelsky A, et al. Surgical treatment of female

- stress urinary incontinence: AUA/SUFU guideline. *J Urol* 2017;198:875-83.
21. Crosby EC, Abernethy M, Berger MB, DeLancey JO, Fenner DE, Morgan DM. Symptom resolution after operative management of complications from transvaginal mesh. *Obstet Gynecol* 2014;123:134-9.
 22. Jong K, Popat S, Christie A, Zimmern PE. Is pain relief after vaginal mesh and/or sling removal durable long term? *Int Urogynecol J* 2018;29:859-64.
 23. Bair MJ, Robinson RL, Katon W, Kroenke K. Depression and pain comorbidity: a literature review. *Arch Intern Med* 2003;163:2433-45.
 24. Katona C, Peveler R, Dowrick C, Wessely S, Feinmann C, Gask L, et al. Pain symptoms in depression: definition and clinical significance. *Clin Med (Lond)* 2005;5:390-5.
 25. Britteon P, Cullum N, Sutton M. Association between psychological health and wound complications after surgery. *Br J Surg* 2017;104:769-76.
 26. Ghoneim MM, O'Hara MW. Depression and postoperative complications: an overview. *BMC Surg* 2016;16:5.
 27. Rosenberger PH, Jokl P, Ickovics J. Psychosocial factors and surgical outcomes: an evidence-based literature review. *J Am Acad Orthop Surg* 2006;14:397-405.
 28. Larouche M, Brotto LA, Koenig NA, Lee T, Cundiff GW, Geoffrion R. Depression, anxiety, and pelvic floor symptoms before and after surgery for pelvic floor dysfunction. *Female Pelvic Med Reconstr Surg* 2018 Apr 23 [Epub]. <http://doi.org/10.1097/SPV.0000000000000582>.
 29. Welk B, Reid J, Kelly E, Wu YM. Association of transvaginal mesh complications with the risk of new-onset depression or self-harm in women with a midurethral sling. *JAMA Surg* 2019;154:358-60.
 30. Thomas D, Demetres M, Anger JT, Chughtai B. Histologic inflammatory response to transvaginal polypropylene mesh: a systematic review. *Urology* 2018;111:11-22.
 31. Nolfi AL, Brown BN, Liang R, Palcsey SL, Bonidie MJ, Abramowitch SD, et al. Host response to synthetic mesh in women with mesh complications. *Am J Obstet Gynecol* 2016;215:206.e1-8.
 32. Hill AJ, Unger CA, Solomon ER, Brainard JA, Barber MD. Histopathology of excised midurethral sling mesh. *Int Urogynecol J* 2015;26:591-5.
 33. Rogo-Gupta L, Grisales T, Huynh L, Rodríguez LV, Raz S. Symptom improvement after prolapse and incontinence graft removal in a case series of 306 patients. *Female Pelvic Med Reconstr Surg* 2015;21:319-24.