Archives of Gynecology and Obstetrics (2019) 299:1007–1013
https://doi.org/10.1007/s00404-019-05076-1

GENERAL GYNECOLOGY

Comparison of different surgical techniques for pelvic floor repair in elderly women: a multi-institutional study

Brannwel Tibi[1,2] · Etienne Vincens[2] · Matthieu Durand[1] · Imad Bentellis[1] · Delphine Salet-Lizee[2] · Aminata Kane[2] · Pierre Gadonneix[2] · François Severac[3] · Youness Ahallal[1] · Daniel Chevallier[1] · Richard Villet[2]

Received: 12 June 2018 / Accepted: 1 February 2019 / Published online: 20 February 2019

Abstract

Purpose The prevalence of pelvic organ prolapse (POP) is increasing. The number of women aged 70–80 years requiring surgical management for POP is also increasing. The purpose of this study was to compare the complications associated with three pelvic organ prolapse repair methods, sacrocolpopexy (SCP), native tissue repair (NTR), and vaginal mesh repair (VMR), in women aged 70–80 years.

Methods We performed a multi-institutional retrospective analysis of 213 women who underwent POP surgical repairs between December 2012 and December 2017. Treatment-related complications were classified using the ClavienDindo grading system and compared among the three groups. Perioperative data, anatomical success rates, patient satisfaction, and postoperative complication data were collected during the follow-up period, which lasted up to 12 months.

Results Of 213 patients, 70 (33%) underwent SCP, 85 (40%) underwent NTR, and 58 (28%) underwent VMR. By postoperative day 30, the all-inclusive complication rate was lower in the SCP group than in the NTR or VMR group; however, there was no between-group difference in complication grade. The VMR group underwent fewer concomitant hysterectomies than the other groups, and operative time was the longest for SCP. Overall, recovery time, anatomical success rate, and patient satisfaction were comparable for all three repairs.

Conclusions All three surgical techniques were equivalent in patient satisfaction, anatomical success rate, and complication rate. SCP should be recommended to elderly women who meet criteria for prolonged general anesthesia, as it was associated with fewer perioperative complications than NTR and VMR.

Keywords Elderly · Native tissue repair · Pelvic organ prolapse · Sacrocolpopexy · Vaginal mesh repair

Abbreviations

ASA	American Society of Anesthesiology
BMI	Body mass index
ICS	International Continence Society
LAM	Levator ani muscle
NTR	Native tissue repair
POP	Pelvic organ prolapse
POP-Q	Pelvic Organ Prolapse Quantification
QOL	Quality of life
SCP	Sacrocolpopexy
SSQ-8	Surgical Satisfaction Questionnaire
TVT	Tension free vaginal tape
VMR	Vaginal mesh repair

✉ Brannwel Tibi
tibi.b@chu-nice.fr

[1] Department of Urology, Hôpital Pasteur 2, CHU Nice, University of Nice-Sophia Antipolis, 30 Voie Romaine, 06000 Nice, France

[2] Department of General Surgery and Gynecology, Diaconesses-Croix Saint Simon Hospital Paris, Paris, France

[3] Department of Public Health, University Hospital of Strasbourg, Strasbourg, France

Introduction

Pelvic organ prolapse (POP) is a global healthcare issue. While it is not a life-threatening condition, POP can have a significant negative impact on pelvic floor function and quality of life (QOL). An estimated one-third of women experience pelvic floor disorders, with prevalence rates increasing with age [1]. Surgical repair aims to restore normal anatomy and function and improve QOL. Among women with POP who are over the age of 80 years, 11% are treated surgically [2]. Advances in surgical and anesthesia techniques have

made it possible to perform major surgical procedures in elderly individuals [3] providing improved functional outcomes and QOL. However, the incidence of degenerative diseases and multiple comorbidities increases with aging [4, 5], thus predisposing patients to a higher risk for postoperative complications, such as bleeding, hematoma, pain, and infections. Considering that advanced age itself is generally a risk factor for morbidity in gynecologic procedures [6, 7], the likelihood of prolonged hospital stays and poor surgical outcomes after pelvic repair surgery increases with age.

Surgical techniques should optimize functional results and minimize complications. For POP surgery, younger women are considered good candidates for sacrocolpopexy (SCP) because of the long-term functional improvements resulting from this procedure [8]. However, women older than 80 years may have satisfactory outcomes and fewer complications with a vaginal repair using mesh (VMR) or native tissue (NTR) [9]. Therefore, with an increasing prevalence of POP and an increasing population of women aged 70–80 years requiring surgical management for POP, our aim was to assess the treatment-related complications associated with SCP, VMR, and NTR in this clinical population.

Methods

We retrospectively evaluated the records of women who underwent POP surgery at two different centers between December 2012 and December 2017. All patients were provided with written information regarding the study and the use of their anonymized data. This study received approval from our institutional review board and was conducted according to the principles outlined in the Declaration of Helsinki.

The study included all patients aged 70–80 years, who were treated for symptomatic anterior, apical, and/or posterior compartment prolapse, stage 2 or greater, according to the Pelvic Organ Prolapse Quantification System (POP-Q). We excluded patients with a previous history of surgery for pelvic cancer or those with a cancer diagnosis. Previous prolapse surgery was not a criterion for exclusion from this study. Presenting symptoms of POP included a vaginal bulge or pelvic heaviness, in accordance with the guidelines from the International Continence Society (ICS).

The baseline evaluation included a complete medical history with identification of medical comorbidities, determination of American Society of Anesthesiologist (ASA) score, and additional information including previous surgery, body mass index (BMI), physical and pelvic examination, multichannel urodynamics study results, and transvaginal ultrasound assessment. The degree of POP was quantified using the POP-Q [10]. The pelvic examination also evaluated concurrent or occult stress urinary incontinence (SUI), with plans made for performance of concomitant mid-urethral sling procedures as indicated. Transvaginal ultrasound was used to exclude fibroids and as part of the preoperative evaluation in preparation for possible concomitant hysterectomy.

Surgical procedures were performed by four surgeons with experience using the three surgical techniques (SCP, VMR and NTR). The surgeries were all performed at two tertiary referral centers. Patient charts were reviewed and the patients were assigned to three categories, according to the type of surgery performed: laparoscopic sacrocolpopexy (SCP), vaginal native tissue repair (NTR), or vaginal mesh repair (VMR).

Laparoscopic SCP was performed under general anesthesia, with or without concomitant subtotal hysterectomy. Either a non-absorbable prosthetic macroporous monofilament polypropylene mesh or a non-absorbable polyester mesh was used for the SCP. Both anterior and posterior vaginal meshes were placed systematically. Anteriorly, the bladder was dissected from the upper half of the anterior vaginal wall to the level of the bladder neck, and the mesh was attached to the anterior vaginal wall using non-absorbable sutures. For posterior mesh placement, a rectovaginal dissection was performed down to the levator ani muscle (LAM), and the mesh was attached to the LAM in the midline near the perineal body. The upper section of the posterior mesh was attached to the uterosacral ligaments using non-absorbable sutures. The anterior mesh was fixed to the sacral promontory, also using non-absorbable sutures. Complete retroperitonealization of the meshes was achieved by closing the peritoneum with an absorbable suture.

NTR and VMR were performed either under general or locoregional anesthesia. NTR consisted of a site-specific surgical repair of the existing defect (anterior and/or posterior) using non-absorbable sutures. Specifically, anterior and/or posterior colporrhaphy was performed for cystoceles and rectoceles, respectively, after adequate hydrodissection of the vesicovaginal or rectovaginal space. Patients with apical prolapse underwent hysterectomy or, for those who wanted to preserve their uterus, hysteropexy. When hysterectomy was performed, a McCall culdoplasty was performed for vaginal vault fixation. A transvaginal Amreich Richter technique for sacrospinous vaginal vault suspension [11] was performed on those who had vaginal vault prolapse after hysterectomy, or if uterine preservation was preferred.

VMR was performed using one of two single-incision mesh systems, the AMS Elevate™ Anterior and Posterior Systems (American Medical Systems, Minnetonka, MN, USA) or the Restorelle Direct Fix® (Coloplast, Minneapolis, MN, USA). In all cases, a single vertical incision was made in the anterior and/or posterior vaginal wall. A full-thickness dissection was performed laterally and apically with respect to the ischial spine. The mesh arm was anchored apically to the sacrospinous ligament, 2 cm medial to the ischial spines

bilaterally. One suture was placed to attach the proximal portion of the graft to the pericervical ring or vaginal cuff in the midline. The excess mesh was appropriately trimmed to fit the vaginal length. For an anterior repair, the bilateral distal arms of the anterior graft were anchored to the obturator internus muscle. One suture was attached from the distal portion of the graft to the vesicourethral junction in the midline. After the mesh was placed without evidence of kinking, the vaginal wall was closed using absorbable sutures. A mid-urethral sling was placed concomitantly in patients with preoperative evidence of symptomatic stress urinary incontinence.

For the primary outcome, data on postoperative complications at month after the procedure were extracted from the medical records and classified using the ClavienDindo grading classifications [12]. Intraoperative adverse events were graded in the same way. Secondary outcomes included perioperative data (type of anesthesia and concomitant surgical procedures, i.e., subtotal or total hysterectomy and mid-urethral sling), operative time, length of hospital stay, anatomical correction, and patient-reported satisfaction with the surgery.

We reviewed the postoperative data from follow-up visits scheduled at 1 and 12 months after surgery, as well as all other documented follow-up visits through 2017. During the scheduled follow-up visits, POP was assessed using the POP-Q quantification system. The surgery was considered to have provided successful anatomical correction if the POP-Q score was less than stage 2 for all compartments at 12 months. Patient satisfaction was assessed using a validated questionnaire (the Surgical Satisfaction Questionnaire: SSQ-8) [13] given at the end of the follow-up period. The questionnaires were sent via postal mail and returned to the research assistant. Patient satisfaction was defined by greater than neutral responses to all items. Finally, recovery time was determined to be the time required to return to normal daily activities, such as household tasks, after surgery.

Fisher's exact test was used to compare categorical variables, and the Kruskal–Wallis test was used to compare continuous variables between the three surgical groups. A p value of < 0.05 was considered to be statistically significant.

Results

The relevant patient characteristics are summarized in Table 1. The analysis was based on the data of 213 patients who underwent POP repairs during the study period, of

Table 1 Characteristics of study patients

Characteristics	Sacrocolpopexy ($n=70$)	Native tissue repair ($n=85$)	Vaginal mesh repair ($n=58$)	P (v)
Age (years) mean ± SD	73.1 ± 2.7	74.8 ± 2.9	73.7 ± 3	$*^{\beta}$(0.002)
BMI mean ± SD	23.6 ± 2.8	24.5 ± 3.2	24.6 ± 3.3	ns^{β}(0.11)
Tobacco n (%)	7 (9.9)	5 (5.9)	2 (3.4)	ns^{α}(0.31)
Medicals comorbidities n (%)				
High blood pressure	29 (41)	37 (43.5)	18 (31)	ns^{α}(0.3)
Dyslipidemia	21 (29.6)	18 (21)	9 (15)	ns^{α}(0.14)
Diabetes	4 (5.6)	8 (9.4)	3 (5.2)	ns^{α}(0.54)
ASA score n (%)				
1	16 (22.5)	18 (21)	14 (24.1)	
2	49 (69)	63 (74.1)	43 (74)	ns^{α}(0.51)
3	6 (8.5)	4 (4.7)	1 (1.7)	
Previous surgery n (%)				
Abdominal surgery	32 (45)	50 (58)	35 (60)	ns^{α}(0.98)
Hysterectomy	16 (22.5)	13 (15)	14 (24)	ns^{α}(0.39)
POP	14 (20)	12 (14)	6 (10)	ns^{α}(0.3)
POP-Q stages n (%)				
II	21 (30)	29 (34)	16 (27.6)	ns^{α}(0.45)
III	40 (57.1)	42 (49.5)	34 (58)	
IV	9 (12.9)	11 (12.9)	8 (13.8)	
SUI n (%)	28 (39.4)	16 (18.8)	20 (34.5)	$*^{\alpha}$(0.011)

SD standard deviation, *BMI* body mass index, *POP* pelvic organ prolapse, *POP-Q* Pelvic Organ Prolapse Quantification, *SUI* stress urinary incontinence, *UUI* urgentury urinary incontinence, α CHI2 or Fisher test, β Kruska–Wallis test, *ns* not statistically significant

$*p < 0.05$

which 70 (33%) underwent SCP, 85 (40%) underwent NTR, and 58 (27%) underwent VMR. The mean age was higher in the NTR group (74.8 ± 2.9 years) than the SCP (73.1 ± 2.7 years) and VMR (73.7 ± 3 years) groups ($p = 0.002$). In the univariate analysis, no differences were identified between the groups with regard to BMI, comorbidities, ASA scores, POP-Q scores, or previous surgeries.

Perioperative data are reported in Table 2. Concomitant hysterectomy was performed less often in patients who had VMR ($p < 0.001$). There was no difference in the placement of urethral slings between the three groups ($p = 0.77$). Perioperative complications occurred in one (1.4%) patient in the SCP group and 3 (5.2%) in the VMR group, although this difference was not significant ($p = 0.08$). Bladder injuries occurred in one (1.4%) patient in the SCP group and one (1.7%) in the VMR group. Vascular injuries occurred in 2 (3.6%) patients in the VMR group. SCP required a significantly longer mean operative time (146.8 min) than NTR (85.2 min) and VMR (72.5 min), and the difference was significant ($p < 0.001$). The median length of hospital stay also differed among the three groups ($p = 0.02$) at 3.2 days for the SCP group, 3.8 days for the NTR group, and 3.7 days for the VMR group. There was no incidence of major organ injury or perioperative mortality.

Postoperative data are reported in Table 3. Complications occurred in 6 (8.6%) patients in the SCP group, 11 (12.9%) in the NTR group, and 14 (24.1%) in the VMR group ($p = 0.037$), with no difference in the ClavienDindo scores between the three groups ($p = 0.13$). Overall, there were 5 (2.3%) grade I, 21 (9.8%) grade II, and 5 (2.3%) grade III postoperative complications. In the VMR group, grade I complications included pain (1.7%) and a hematoma (3.4%); grade II included urinary tract infection (10.3%), one de novo case of cardiac arrhythmia (1.7%) and acute urinary retention (3.4%); and grade III complications included hematoma requiring surgical evaluation (1.7%) and one (1.7%) reoperation with incision to correct a dysfunctional mid-urethral sling. In the SCP group, grade I complications included function bowel obstruction (1.4%); grade II included acute urinary retention (1.4%), urinary tract infection (2.8%), and cardiac arrhythmia (1.4%); grade III included bowel obstruction that required intervention

Table 2 Analysis of perioperative data from sacralcolpopexy group, the native tissue repairsurgery group and the mesh repair group

	Sacrocolpopexy ($n = 70$)	Native tissue repair ($n = 85$)	Vaginal mesh repair ($n = 58$)	p^{β}
Concomittant hysterectomy *n* (%)	35 (50)	63 (74)	4 (7)	$*^{\alpha}(< 0.001)$
Associated urethral sling *n* (%)	15 (21.4)	22 (26)	13 (22.4)	$ns^{\alpha}(0.79)$
Operative time (min) mean ± SD	148 ± 60.31	85.2 ± 24.2	72.1 ± 24.4	$*^{\beta}(0 < 0.001)$
Intraoperative complications *n* (%)	1 (1.4)	0	3 (5.2)	$ns^{\alpha}(0.08)$
Hospital stay (days) median [min–max]	3.2 [1–9]	3.83 [2–8]	3.71 [2–9]	$*^{\beta}(0.02)$
Type of anesthesia *n* (%)				
GA	70 (100)	28 (32.9)	21 (36.2)	$*^{\beta}(0 < 0.001)$
LRA	0	57 (67.1)	36 (62.1)	

SD standard deviation, *GA* general anesthesia, *LRA* locoregional anesthesia, *α* Fisher test, *β* Kruska–Wallis test, *ns* not statistically significant

$*p < 0.05$

Table 3 Analysis of postoperative data from sacralcolpopexy group, the traditional surgery group and the mesh repair group

	Sacrocol-popexy ($n = 70$)	Native tissue repair ($n = 85$)	Vaginal mesh repair ($n = 58$)	p^{β}
Post-operative complications *n* (%)	6 (8.6)	11 (12.9)	14 (24.1)	$*^{\alpha}(0.039)$
Claviendindo Score *n* (%)				
I	1 (1.4)	1 (1.1)	3 (5.1)	$ns^{\alpha}(0.13)$
II	4 (5.7)	8 (9.4)	9 (15.5)	
III	1 (1.4)	2 (2.4)	2 (3.4)	
Lost to follow-up *n* (%)	4 (5.7)	6 (7)	6 (10)	$ns^{\alpha}(0.6)$
Recovery time (month) mean ±SD	1.2 ± 1.15	1.24 ± 1.02	1.09 ± 0.58	$ns^{\beta}(0.68)$
Anatomical correction at 1 year *n* (%)	63 (95)	72 (91)	51 (98)	$ns^{\alpha}(0.2)$
Surgical satisfaction *n* (%)	60 (90)	78 (98)	51 (98)	$ns^{\alpha}(0.3)$

α Fisher test, *β* Kruska–Wallis test, *ns* not statistically significant, *SD* standard deviation

$*p < 0.05$

(1.4%). In the NTR group, only 2 (2.3%) hematomas that required surgical evacuation (grade III) were identified as postoperative complications. The 1-year anatomical success rate was 95% in the SCP group, 91% in the NTR group, and 98% in the VMR group ($p = 0.2$).

Postoperative data after the 1-year follow-up visit was available for 197 patients. Sixteen patients (7%) were lost to follow-up. The mean recovery time was 1.2 months in the SCP group, 1.24 months in the NTR group, and 1.09 months in the VMR group ($p = 0.69$). Patient-reported satisfaction was similar for all three surgical repair types ($p = 0.3$; Table 3), with a satisfaction rate of 90% in the SCP group, 98% in the NTR group, and 98% in the VMR group.

Discussion

To date, no guidelines have been established regarding the preferred surgical approach to POP repair for elderly women. Although the number of women aged 70–80 years in the general population is increasing, few older women are included in surgical trials for pelvic floor disorders [14]. Furthermore, it is highly likely that problems associated with POP in this population are underestimated [15]. To the best of our knowledge, this is the first report to compare surgical outcomes of different techniques used for the treatment of POP in this segment of the population. Based on our study results, we found that SCP, NTR, and VMR were all effective corrective techniques for POP in women aged 70–80 years, with no specific age-related complications identified. It is our opinion that all three surgery types should be offered to women in this age range, and that age alone should not exclude women from seeking the benefits and efficacy of SCP.

The incidence of comorbidities, including cardiovascular disease, chronic pulmonary disease, diabetes and neurological conditions, increases with age [16]. These conditions can predispose patients to postoperative complications that can significantly compromise surgical outcomes. In younger women, SCP has been shown to provide better long-term outcomes than NTR or VMR, and many physicians consider it to be the best option for POP repair [17]. To date, the functional outcomes, operative characteristics, and complications associated with these different surgical repairs have only been evaluated in women under the age of 70 years. The benefits of SCP must be balanced against its longer operative time, requirement for general anesthesia, and increased cost of its abdominal approach [17]. Intuitively, one might consider that older women would not receive the same long-term efficacy benefits after SCP because of their relatively limited life expectancy. Moreover, as shown in our study, the SCP procedure requires a significantly longer operative time than either NTR or VMR, which increases the risk of surgical and anesthesia-related morbidities. The effects of anesthesia on cognitive outcomes has been extensively studied, with no significant differences in postoperative cognitive function having been demonstrated between general and regional anesthetic techniques [3]. In a meta-analysis of 141 clinical trials that included 9559 patients, Rodgers et al. [18] reported a lower rate of postoperative morbidity and overall 30-day mortality with regional than with general anesthesia, independent of the surgical procedure performed. We did not identify any effects related to anesthesia type (general or local) on perioperative complications, hospital stay, or postoperative recovery time. However, both patients who developed de novo cardiac arrhythmias underwent different procedures under general anesthesia. The length of time required to return to activities after surgery is an important factor to consider, as decreased autonomy and disability after surgery can increase the risk of mortality [19]. Table 3 shows similar (approximately 1 month) recovery times for the three surgical groups in our study.

Complications related to surgical dissection were more frequent than complications related to the implanted prostheses, with no incidence of mesh erosion over the duration of our follow-up period. In a review by Ganatra et al. [20], the mean incidence of mesh erosion after SCP was 2.7% (range 0–9%) over a mean follow-up period of 24.6 months, with an estimated time-to-erosion of 6–36 months. For the VMR procedure, a mean incidence rate of mesh erosion of 4–35.7% has been reported [21]. In our study, the same low-weight, macroporous mesh was systematically used, which may explain the lack of erosion observed over the duration of the follow-up period. Routine hysterectomy was avoided in the VMR group due to the increased risk for mesh exposure [22]. Mesh erosion is not only related to the surgical technique used, but is also influenced by the surgeon's skill, as well as patient-related risk factors, such as urogenital atrophy and smoking. In a retrospective study, all the risk factors for each individual patient cannot necessarily be identified. Therefore, additional study with a longer follow-up period is needed to confirm the incidence of mesh erosion in older women after POP repair.

The objective evaluations of anatomical corrections at 1-year follow-up were similar for all the procedures (Table 3). Maher et al. [23] and Agarwala et al. [24] reported success rates of 77–100% for the SCP procedure. In a recent review [21], the success rate for VMR was estimated at 43–93% at 1-year postoperative follow-up, with a POP stage ≤ 1 being the primary criteria defining success. Su et al. [25] reported an overall success rate of 97% at 1-year after surgery using the Elevate™ mesh for POP repair. We noted a higher success rate for NTR (92%) in our cases series than that was previously reported. Keys et al. [21] reported a 41–72% success rate for NTR, while Su et al. [25] reported a success rate of 87% at 1 year.

Nieminem et al. [26] reported an objective cure rate of 59% at 3 years after surgery. It is possible that our higher than expected rate of success with NTR was influenced by our relatively short 1-year follow-up period. Furthermore, we should consider that the women in our study group were older and may have had less frequent and/or less intense physical activity after surgery.

The majority of patients in our study were satisfied with the repair outcomes, which were comparable to the previously reported satisfaction rates of 97% for SCP [8], 100% for VMR [26] and 98–100% for NTR [28].

Our study was a non-randomized retrospective analysis. Several limitations are therefore inherent; however, we made several efforts to minimize these limiting biases. We minimized selection bias by including all patients who underwent surgery for POP in our health information system. We minimized recall bias using objective, well-defined measures to classify our medical history, medical exams, and outcomes. In addition, our primary outcome measures (length of stay, operative time, and intraoperative and postoperative complications) were recovered from electronic medical records and, therefore, were not subject to recall bias. Finally, we used the modified ClavienDindo score to objectively classify the numbers and types of complications after surgery. Another bias was based on the differences in procedures within the same group (concomitant mid-urethral sling in all groups, concomitant hysterectomy in the SCP and NTR groups, Richter or McCall procedures in the NTR group, and the use of different mesh systems in the VMR group). However, few complications were directly related to any specific procedure in our study, with only one case of reoperation to repair a dysfunctional mid-urethral sling.

In conclusion, all three POP repair procedures, SCP, NTR, and VMR, were effective among women aged 70–80 years, with no specific age-related complications identified. We conclude that all options for surgery should be offered to women in this age group, being mindful of the generally higher rate of mesh complication with VMR than either SCP or NTR. Age alone should not exclude women from seeking the benefits of SCP, with the hypothetical risk of significant complications in this age group not supported by our findings. A prospective study, with a longer follow-up, seems necessary to validate these results.

Author contributions BT: Project development, data collection, and manuscript writing; EV: Project development and reviewing of the manuscript; MD: Reviewing and editing of the manuscript; DSL: Project development and manuscript reviewing and editing; AK: Project development; PG: Project development; IB: Editing of the manuscript; FS: Data analysis; YA: Editing of the manuscript; DC: Project development; RV: Supervisor, Study validation.

Funding There was no funding obtained for this study.

Compliance with ethical standards

Conflict of interest The authors affirm that they have no conflicts of interest to declare.

Research involving human participants and/or animals All procedures performed in these studies that involved human participants were conducted in accordance with the ethical standards of our institutional ethics review committee and adhered to the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This study was approved by our institutional ethics review board.

Clinical Trial NCT03445442.

Informed consent All patients were notified about the use of their de-identified medical data in our retrospective analysis.

References

1. Samuelsson EC, Victor FT, Tibblin G, Svärdsudd KF (1999) Signs of genital prolapse in a Swedish population of women 20–59 years of age and possible related factors. Am J Obstet Gynecol 180:299–305
2. Olsen AL, Smith VJ, Bergstrom JO, Colling JC, Clark AL (1997) Epidemiology of surgically managed pelvic organ prolapse and urinary incontinence. Obstet Gynecol 89:501–506
3. Williams-Russo P, Sharrock NE, Mattis S, Szatrowski TP, Charlson ME (1995) Cognitive effects after epidural vs general anesthesia in older adults. A randomized trial. JAMA 274:44–50
4. Luber KM, Boero S, Choe JY (2001) The demographics of pelvic floor disorders: current observations and future projections. Am J Obstet Gynecol 184:1496–1501 **(discussion, 1501–1503)**
5. Stepp KJ, Barber MD, Yoo EH, Whiteside JL, Paraison FR, Walters D (2005) Incidence of perioperative complications of urogynecologic surgery in elderly women. Am J Obstet Gynecol 192:1630–1636
6. Tabata T, Yamawaki T, Ida M, Nishimura K, Nose Y, Yabana T (2001) Clinical value of dilatation and curettage for abnormal uterine bleeding. Arch Gynecol Obstet 264:174–176
7. Hornemann A, Kamischke A, Luedders DW, Beyer DA, Diedrich K, Bohlmann MK (2010) Advanced age is a risk factor for higher grade perineal lacerations during delivery in nulliparous women. Arch Gynecol Obstet 281:59–64
8. Sabbagh R, Mandron E, Piussan J, Brychaert PE, Tu LM (2010) Long-term anatomical and functional results of laparoscopic promontofixation for pelvic organ prolapse. BJU Int 106:861–866
9. Gerten KA, Markland AD, Lloyd LK, Richter HE (2008) Prolapse and incontinence surgery in older women. J Urol 179:2111–2118
10. Visco AG, Visco AG, Wei JT, McClure LA, Handa VL, Nygaard IE (2003) Effects of examination technique modifications on pelvic organ prolapse quantification (POP-Q) results. Int Urogynecol J Pelvic Floor Dysfunct 14:136–140
11. Giuly J, Cravello L, D'Ercole C, Roger V, Porcu G, Blanc B (1997) Richter's spinofixation in vaginal prolapse. Chir Mem Acad Chir 122:430–434 **(French)**
12. Dindo D, Demartines N, Clavien P (2004) Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg 240:205–213
13. Murphy M, Sternschuss G, Haff R, van Raalte H, Saltz S, Lucente V (2008) Quality of life and surgical satisfaction after vaginal reconstructive vs obliterative surgery for the treatment of advanced pelvic organ prolapse. Am J Obstet Gynecol 198:573

14. King SW, Jefferis H, Jackson S, Marfin AG, Price N (2017) Laparoscopic uterovaginal prolapse surgery in the elderly: feasibility and outcomes. Gynecol Surg 14:2
15. Sung VW, Weitzen S, Sokol ER, Rardin CR, Myers DL (2006) Effect of patient age on increasing morbidity and mortality following urogynecologic surgery. Am J Obstet Gynecol 194:1411–1417
16. Leung JM, Dzankic S (2001) Relative importance of preoperative health status versus intraoperative factors in predicting postoperative adverse outcomes in geriatric surgical patients. J Am Geriatr Soc 49:1080–1085
17. Maher C, Feiner B, Baessler K, Schmid C (2013) Surgical management of pelvic organ prolapse in women. Cochrane Database Syst Rev. https://doi.org/10.1002/14651858.CD004014.pub5
18. Rodgers A, Walker N, Schug S, McKee A, Kehlet H, van Zundert A, Sage D, Futter M, Saville G, Clark T, MacMahon S (2000) Reduction of postoperative mortality and morbidity with epidural or spinal anaesthesia: results from overview of randomised trials. BMJ 321:1493
19. Greer JA, Northington GM, Harvie HS, Segal S, Johnson JC, Arya LA (2013) Functional status and postoperative morbidity in older women with prolapse. J Urol 190:948–952
20. Ganatra AM, Rozet F, Sanchez-Salas R, Barret E, Galiano M, Cathelineau X, Vallancien G (2009) The current status of laparoscopic sacrocolpopexy: a review. Eur Urol 55:1089–1103
21. Keys T, Campeau L, Badlani G (2012) Synthetic mesh in the surgical repair of pelvic organ prolapse: current status and future directions. Urology 80:237–243
22. Belot F, Collinet P, Debodinance P, Duc H, Lucot JP, Cosson M (2005) Risk factors for prosthesis exposure in treatment of genital prolapse via the vaginal approach. Gynecol Obstet Fertil 33:970–974
23. Maher CF, Feiner B, DeCuyper EM, Nichlos CJ, Hickey KV, O'Rourke P (2011) Laparoscopic sacral colpopexy versus total vaginal mesh for vaginal vault prolapse: a randomized trial. Am J Obstet Gynecol 204:360
24. Agarwala N, Hasiak N, Shade M (2007) Laparoscopic sacral colpopexy with Gynemesh as graft material—experience and results. J Minim Invasive Gynecol 14:577–583
25. Su TH, Lau HH, Huang WC, Hsieh CH, Chang RC, Su CH (2014) Single-incision mesh repair versus traditional native tissue repair for pelvic organ prolapse: results of a cohort study. Int Urogynecol J 25:901–908
26. Nieminen K, Hiltunen R, Takala T, Heiskanen E, Merikari M, Niemi K, Heinonen PK (2010) Outcomes after anterior vaginal wall repair with mesh: a randomized, controlled trial with a 3 year follow-up. Am J Obstet Gynecol 203:235
27. Moore RD, Miklos JR (2009) Vaginal repair of cystocele with anterior wall mesh via transobturator route: efficacy and complications with up to 3-year followup. Adv Urol 78:15. https://doi.org/10.1155/2009/743831
28. Lee U, Wolff EM, Kobashi KC (2012) Native tissue repairs in anterior vaginal prolapse surgery: examining definitions of surgical success in the mesh era. Curr Opin Urol 22:265–270