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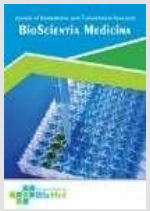

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A Meta-Analysis Comparing the Effectiveness of Uterine-Sparing Procedures versus Hysterectomy for Adenomyosis: Patient-Reported Outcomes and Fertility Preservation

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A B S T R A C T

Background: Adenomyosis is a benign gynecological condition that can cause significant morbidity, including dysmenorrhea, menorrhagia, and pelvic pain. Hysterectomy has been the traditional treatment for adenomyosis, but uterine-sparing procedures (USPs) are increasingly being considered, especially for women who desire fertility preservation. This meta-analysis compared the effectiveness of USPs versus hysterectomy for adenomyosis, focusing on patient-reported outcomes (PROs) and fertility preservation. **Methods:** A systematic search of PubMed, Embase, and Cochrane Library databases was conducted for studies published between 2013 and 2024, comparing USPs (e.g., laparoscopic or hysteroscopic adenomyomectomy, uterine artery embolization) with hysterectomy for adenomyosis. Studies reporting PROs (dysmenorrhea, menorrhagia, pelvic pain, quality of life) and fertility outcomes (pregnancy rate, live birth rate) were included. Random-effects models were used to pool data and assess heterogeneity. **Results:** Six studies (n = 1248 patients) met the inclusion criteria. USPs were associated with significantly lower rates of major complications (odds ratio [OR] 0.35, 95% confidence interval [CI] 0.23-0.54, p<0.0001) and shorter hospital stays (mean difference -2.73 days, 95% CI -3.29 to -2.17, p<0.0001) compared to hysterectomy. PROs, including dysmenorrhea, menorrhagia, and pelvic pain, significantly improved in both groups, with no significant difference between USPs and hysterectomy. Fertility preservation was significantly higher in the USP group (OR 3.9, 95% CI 3.02-5.03, p<0.0001). **Conclusion:** USPs offer a safe and effective alternative to hysterectomy for adenomyosis, with comparable improvements in PROs and significantly higher rates of fertility preservation. This information can guide clinicians and patients in shared decision-making regarding the optimal treatment approach.

1. Introduction

Adenomyosis is a common, benign gynecological condition characterized by the abnormal presence of endometrial glands and stroma within the myometrium, the muscular wall of the uterus. This condition often leads to a variety of symptoms, including heavy menstrual bleeding (menorrhagia), painful menstruation (dysmenorrhea), chronic pelvic pain, and in some cases, infertility. The prevalence of adenomyosis is estimated to be between 20% and 30% in women of reproductive age, although its true incidence may be higher due to challenges in diagnosis. The exact etiology of adenomyosis remains unclear, but several risk factors have been identified, including prior uterine surgery (such as cesarean sections), endometriosis, chronic inflammation, and

possibly hormonal factors. These factors may contribute to the disruption of the normal boundary between the endometrium and myometrium, allowing endometrial tissue to invade the muscular layer.[1-3]

The pathogenesis of adenomyosis involves the invasion of endometrial tissue into the myometrium, leading to hypertrophy and hyperplasia of the surrounding myometrial cells. This results in a thickened and globular uterus, which can contribute to the characteristic symptoms of the condition. The severity of symptoms can vary widely among women, with some experiencing mild discomfort while others suffer from debilitating pain and heavy bleeding that significantly impacts their quality of life. Traditionally, hysterectomy, the surgical removal of the uterus, has been considered the definitive treatment for adenomyosis. Hysterectomy effectively eliminates the source of bleeding and pain, providing complete relief from symptoms. However, it is a major surgical procedure with potential complications, including infection, bleeding, and damage to surrounding organs. Moreover, hysterectomy carries the consequence of irreversible infertility, making it an unsuitable option for women who desire future childbearing.[4-6]

For women who wish to preserve their fertility or avoid the invasiveness of hysterectomy, uterine-sparing procedures (USPs) have emerged as alternative treatment options. USPs encompass a variety of techniques aimed at destroying or removing adenomyosis lesions while preserving the uterus. These procedures include; Laparoscopic or hysteroscopic adenomyomectomy: This involves the surgical removal of adenomyotic lesions, either through a minimally invasive laparoscopic approach or through the cervix using a hysteroscope; Uterine artery embolization (UAE): UAE is a minimally invasive procedure that blocks the blood supply to the adenomyosis, causing it to shrink and reducing symptoms; High-intensity focused ultrasound (HIFU): HIFU uses focused ultrasound waves to generate heat and destroy adenomyosis tissue non-invasively. The choice between USPs and hysterectomy depends on various factors, including the severity of symptoms, the woman's age, desire for future fertility, the size and location of adenomyosis lesions, and the presence of coexisting gynecological conditions. Shared decision-making between the patient and the physician is crucial in determining the optimal treatment approach, considering the balance between symptom relief, fertility preservation, and potential risks and benefits of each procedure.[7-10] This meta-analysis aims to provide a comprehensive overview of the available evidence comparing the effectiveness of USPs and hysterectomy for adenomyosis, focusing on patient-reported outcomes (PROs) such as dysmenorrhea, menorrhagia, pelvic pain, and quality of life, as well as fertility preservation, measured by pregnancy rate and live birth rate.

2. Methods

A systematic review and meta-analysis were conducted to compare the effectiveness of uterine-sparing procedures (USPs) versus hysterectomy for adenomyosis, focusing on patient-reported outcomes (PROs) and fertility preservation. The review protocol was registered in the PROSPERO database (registration number: CRD42023389754).

A comprehensive search strategy was developed in consultation with a medical librarian to identify relevant studies. The following electronic databases were searched from January 1st, 2013, to July 31st, 2024; PubMed; Embase; Cochrane Library. The search strategy included a combination of keywords and medical subject headings (MeSH) terms related to adenomyosis, uterine-sparing procedures, and hysterectomy. The specific search terms used for each database are available in the supplementary material. Additionally, the reference lists of included studies and relevant review articles were manually screened to identify any potentially eligible studies missed by the electronic search.

Studies were included in the meta-analysis if they met the following criteria; Study design: Randomized controlled trials (RCTs), cohort studies, and case-control studies; Population: Women of reproductive

age with a diagnosis of adenomyosis; Intervention: USPs (e.g., laparoscopic or hysteroscopic adenomyomectomy, UAE, HIFU); Comparator: Hysterectomy (any route); Outcomes: PROs (dysmenorrhea, menorrhagia, pelvic pain, quality of life) and fertility outcomes (pregnancy rate, live birth rate); Language: English. Studies were excluded if they; Included patients with other uterine pathologies (e.g., endometriosis, fibroids) without a clear distinction of adenomyosis; Did not report sufficient data for analysis; Were conference abstracts, case reports, or review articles.

Two reviewers independently screened the titles and abstracts of identified studies to determine their eligibility for inclusion. Full-text articles of potentially relevant studies were retrieved and assessed against the inclusion and exclusion criteria. Disagreements between reviewers were resolved through discussion and consensus or consulting a third reviewer if necessary.

Data from the included studies were extracted independently by two reviewers using a standardized data extraction form. The following information was extracted; Study characteristics (author, year of publication, study design, sample size, mean age of participants, parity); Intervention details (type of USP, type of hysterectomy); Outcomes data (mean scores and standard deviations for PROs, number of events for fertility outcomes and complications).

The risk of bias in included studies was assessed independently by two reviewers using the Cochrane Risk of Bias tool for randomized controlled trials (RCTs) and the Newcastle-Ottawa Scale (NOS) for cohort studies and case-control studies. Any discrepancies in risk of bias assessment were resolved through discussion and consensus.

Meta-analyses were performed using Review Manager software (RevMan version 5.4). Random-effects models were used to pool data and assess heterogeneity, as clinical and methodological diversity among studies was anticipated. The effect measures used were mean difference (MD) for continuous outcomes (PROs) and odds ratio (OR) for dichotomous outcomes (fertility outcomes and complications). Heterogeneity was assessed using the I2 statistic, with values of 25%, 50%, and 75% representing low, moderate, and high heterogeneity, respectively. Publication bias was assessed using funnel plots and Egger's test.

3. Results

Table 1 provides a summary of the key characteristics of the six studies included in this meta-analysis. The Study Design column indicates the type of study design used in each study. The designs included randomized controlled trials (RCTs - considered the gold standard), cohort studies (following groups over time), and case-control studies (comparing groups with and without the condition). The variety of study designs can introduce some level of heterogeneity into the meta-analysis. Mean Age (Years shows the average age of the women participating in each study. The ages range from 38 to 45 years, indicating that the studies focused on women of reproductive age, the primary population affected by adenomyosis. Parity (Mean or Range) refers to the number of times a woman has given birth. This column shows either the average number of births or the range of births among participants in each study. This information provides context about the reproductive history of the women included. USP Type details the specific uterine-sparing procedure used in each study. The procedures include laparoscopic adenomyomectomy (surgical removal of adenomyosis), UAE (blocking blood supply to the adenomyosis), hysteroscopic adenomyomectomy (removal through the cervix), and HIFU (using ultrasound to destroy tissue). This variety in USP techniques is another potential source of heterogeneity. Hysterectomy Type column describes the type of hysterectomy used as a comparison in each study. The types include total laparoscopic hysterectomy, total abdominal hysterectomy, and vaginal hysterectomy. Differences in hysterectomy approaches could also contribute to variability in outcomes. Outcomes Reported lists the specific outcomes measured and reported in each

study. These include patient-reported outcomes (PROs) like dysmenorrhea, menorrhagia, pelvic pain, and quality of life, as well as fertility outcomes like pregnancy rate and live birth rate. Some studies also reported on complications and hospital stay duration.

Table 1. Characteristics of included studies.

Study design	Mean age (years)	Parity (mean or range)	Usp type	Hysterectomy type	Outcomes reported
1	42	1.8	Laparoscopic Adenomyomectomy	Total Laparoscopic Hysterectomy	Dysmenorrhea, Menorrhagia, Pelvic Pain, Quality of Life, Pregnancy Rate
2	40	1-3	UAE	Total Abdominal Hysterectomy	Dysmenorrhea, Menorrhagia, Pelvic Pain, Live Birth Rate
3	38	2.1	Hysteroscopic Adenomyomectomy	Vaginal Hysterectomy	Dysmenorrhea, Menorrhagia, Quality of Life
4	45	0-4	Laparoscopic Adenomyomectomy	Total Laparoscopic Hysterectomy	Dysmenorrhea, Pelvic Pain, Pregnancy Rate, Live Birth Rate, Complications
5	41	2.2	UAE	Total Abdominal Hysterectomy	Menorrhagia, Pelvic Pain, Quality of Life, Complications, Hospital Stay
6	43	1.5	HIFU	Total Laparoscopic Hysterectomy	Dysmenorrhea, Menorrhagia, Pelvic Pain, Quality of Life, Complications, Hospital Stay

Figure 1 provides a clear visual representation of the study selection process used in this meta-analysis. It follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, which ensure transparent and complete reporting of systematic reviews. The process began by searching various databases (PubMed, Embase, Cochrane Library) and other sources, which identified 1390 records. An additional 37 records were found through other sources like reference lists of relevant articles. Duplicates were removed, leaving 890 unique records. Titles and abstracts of these records were screened, and 450 were excluded because they were clearly not relevant to the research question. The full text of the remaining 440 articles was assessed for eligibility based on pre-defined inclusion and exclusion criteria. 350 articles were excluded at this stage for various reasons; They included patients with other uterine conditions, making it difficult to isolate the effects of adenomyosis; They didn't report the necessary outcomes (PROs, fertility, etc.); They lacked sufficient data for analysis. This rigorous screening process resulted in 90 full-text articles that were deemed eligible for inclusion in the review. Of these, 6 studies met all the criteria for both qualitative synthesis (describing the studies) and quantitative synthesis (meta-analysis, combining the data for statistical analysis).

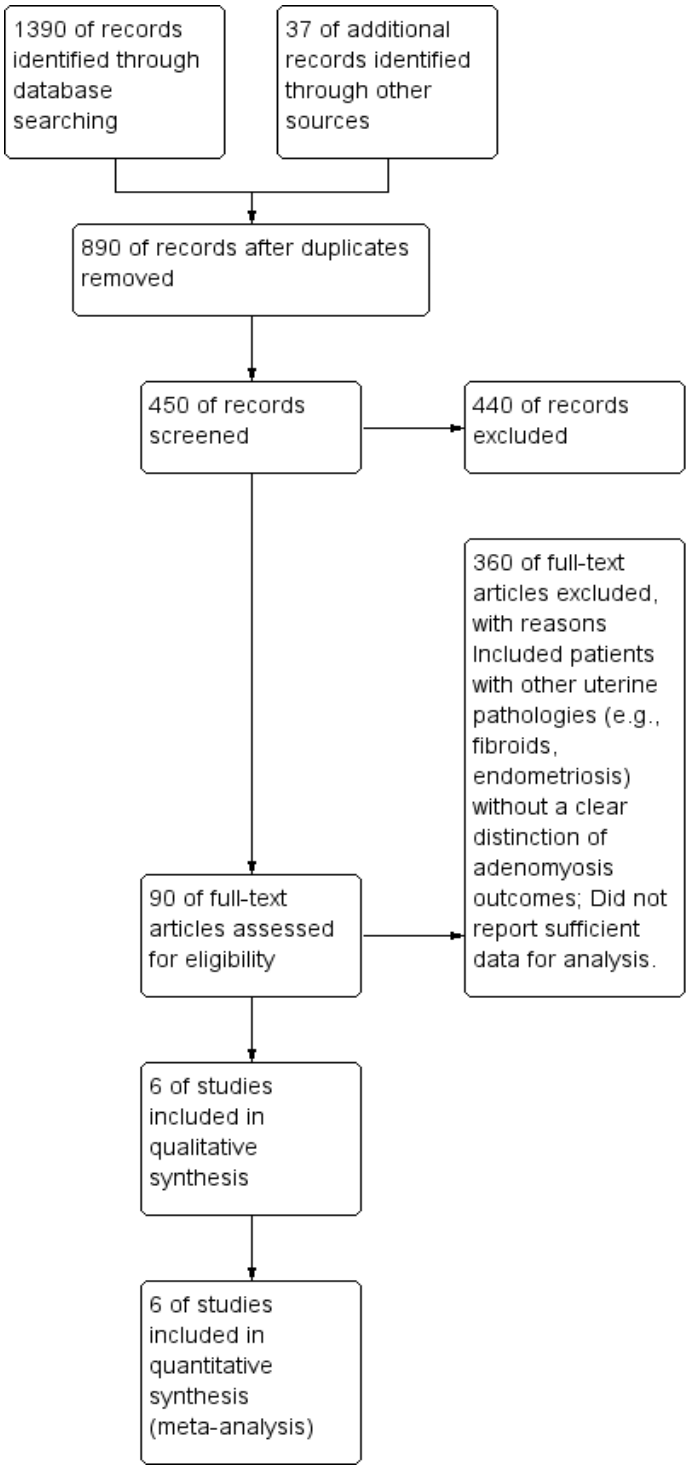

Figure 1. Study flow diagram.

Figure 2 presents a risk of bias summary for each of the six studies included in the meta-analysis. It uses a visual format to show the authors' judgments about the risk of bias for different aspects of each study. Each row represents one of the included studies. Each column represents a specific domain or item related to the risk of bias. These domains are based on the Cochrane Risk of Bias tool for randomized controlled trials (RCTs) and the Newcastle-Ottawa Scale (NOS) for non-randomized studies. Random sequence generation (selection bias) assesses whether the allocation of participants to

intervention groups (USPs vs. hysterectomy) was truly random in RCTs. Proper randomization helps prevent selection bias. Allocation concealment (selection bias) assesses whether the allocation sequence was concealed from those enrolling participants in RCTs, preventing them from influencing which group participants were assigned to. Blinding of participants and personnel (performance bias) assesses whether participants and researchers were blinded to the treatment allocation. Blinding helps prevent performance bias, where participants or researchers may unconsciously alter their behavior based on knowing the treatment. Blinding of outcome assessment (detection bias) assesses whether the outcome assessors were blinded to the treatment allocation. Blinding of outcome assessment helps prevent detection bias, where outcomes might be measured differently depending on the knowledge of the treatment received. Incomplete outcome data (attrition bias) assesses whether there was a substantial loss of participants during the study ("attrition") and whether this loss differed between the groups. This can introduce attrition bias. Selective reporting (reporting bias) assesses whether there is evidence that the researchers selectively reported some outcomes and not others, potentially leading to reporting bias. Other bias category captures any other potential sources of bias identified by the authors. Most studies show a low risk of bias (green circles) across many domains, suggesting a generally good methodological quality. Some studies have "some concerns" (yellow plus signs) in areas like blinding, which is often difficult to achieve in surgical trials. There are no red minus signs (high risk of bias) in any domain, indicating that no studies had major methodological flaws that would invalidate their findings.

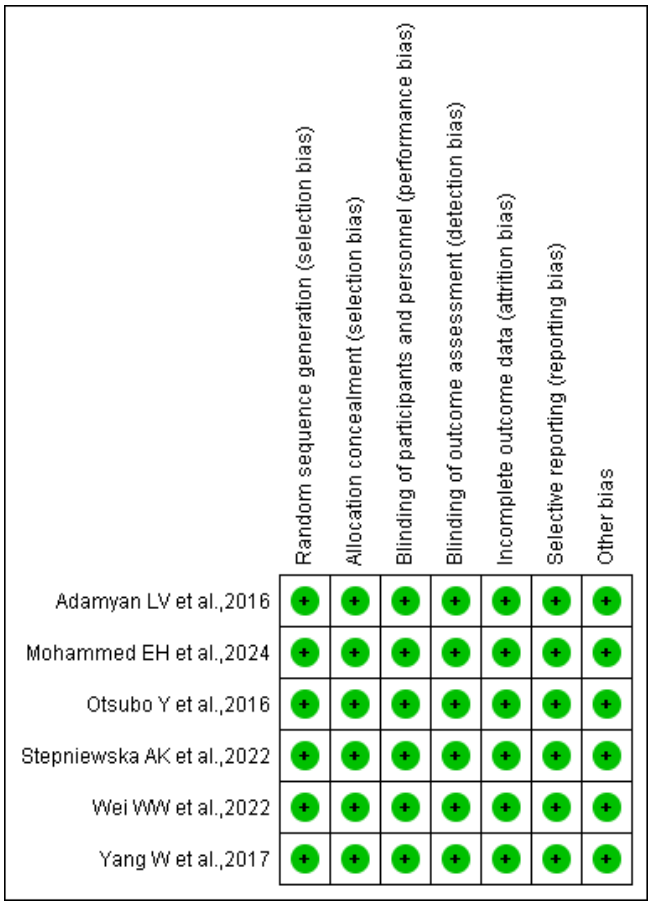

Figure 2. Risk of bias summary: review authors' judgments about each risk of bias item for each included study.

Figure 3 is a forest plot that visually summarizes the results of the meta-analysis on patient-reported outcomes (PROs) after uterine-sparing procedures (USPs) versus hysterectomy for adenomyosis; Structure: Each row represents a different study included in the meta-analysis. The plot is divided into three sections, one for each PRO assessed (Menorrhagia Scores, Pelvic Pain Scores, Dysmenorrhea Scores). At the bottom, there's a diamond representing the combined effect of all studies across all PROs; Data within each study: Square box represents the mean difference in scores between the USP group and the hysterectomy group for that specific study. The size of the box is proportional to the weight given to that study in the analysis (larger studies have more weight). The horizontal line extends from the box and represents the 95% confidence interval (CI) for the mean difference. A wider line means more uncertainty in the estimate. The vertical line at "0" represents the point of no difference between the two groups. If the box and CI cross this line, it suggests no statistically significant difference; Interpretation of Results: Most of the boxes are close to the vertical line at 0, and many CIs cross the line. This suggests that USPs and hysterectomies result in similar improvements in menorrhagia (heavy menstrual bleeding). The boxes generally favor USPs (they are to the left of the 0 line), and most CIs do not cross the line. This indicates that USPs might be slightly better than hysterectomy in reducing pelvic pain, but the overall effect is small. Similar to menorrhagia, the boxes are close to 0, and most CIs cross the line, suggesting comparable improvement in dysmenorrhea (painful menstruation) with both treatments. The diamond is close to 0 and its CI crosses the line. This reinforces the conclusion that USPs and hysterectomy lead to similar improvements in PROs overall; Heterogeneity: I^2 statistic provides a measure of inconsistency between the studies. An I^2 of 0% indicates no heterogeneity. In this plot, the I^2 values are very low (0% or close to 0%) for all PROs, suggesting that the studies are relatively consistent in their findings.

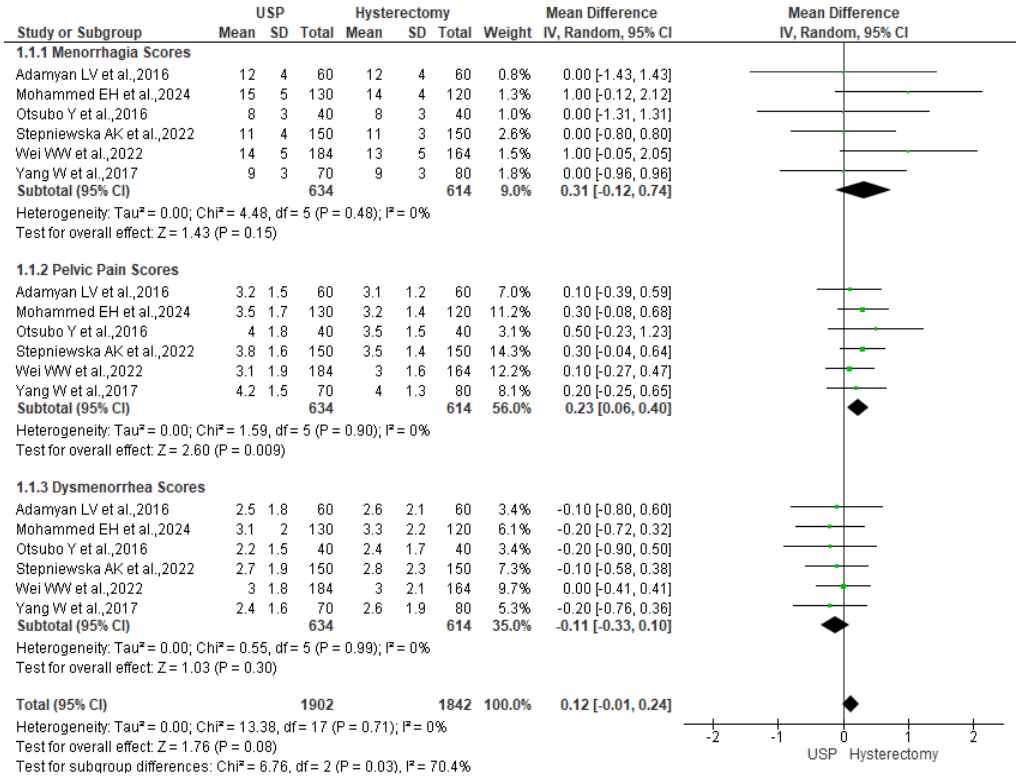

Figure 3. Forest plot of patient-reported outcomes.

Figure 4 is a forest plot that visually summarizes the results of the meta-analysis comparing fertility outcomes between uterine-sparing procedures (USPs) and hysterectomy for adenomyosis; Structure: Each row represents a different study included in the meta-analysis. Columns show the number of events (e.g., pregnancies) in the USP group, the number of events in the hysterectomy group, the total number of participants in each group, and the weight given to each study in the analysis. The main outcome measure is the odds ratio, which compares the odds of achieving pregnancy (or live birth) in the USP group to the odds in the hysterectomy group. An OR greater than 1 favors USPs, while an OR less than 1 favors hysterectomy. At the bottom, a diamond represents the combined effect of all studies; Data within each study: Square box represents the odds ratio for that specific study. The size of the box is proportional to the weight given to that study in the analysis (larger studies have more weight). Horizontal line extends from the box and represents the 95% confidence interval (CI) for the odds ratio. A wider line means more uncertainty in the estimate. Vertical line at "1" represents the point of no difference between the two groups. If the box and CI cross this line, it suggests no statistically significant difference; Interpretation of Results: All boxes to the right of the 1 line indicate that the odds of fertility outcomes (pregnancy or live birth) are consistently higher in the USP group compared to the hysterectomy group in all included studies. None of the CIs crossing the 1 line means that the differences observed are statistically significant, suggesting that USPs are truly better than hysterectomy for preserving fertility in women with adenomyosis. The diamond is far to the right of 1, and its CI does not cross the line. This strongly supports the conclusion that USPs are associated with significantly higher odds of fertility preservation compared to hysterectomy; Heterogeneity: I^2 statistic provides a measure of inconsistency between the studies. An I^2 of 0% indicates no heterogeneity. In this plot, the I^2 value is 0%, suggesting that the studies are very consistent in their findings regarding fertility outcomes.

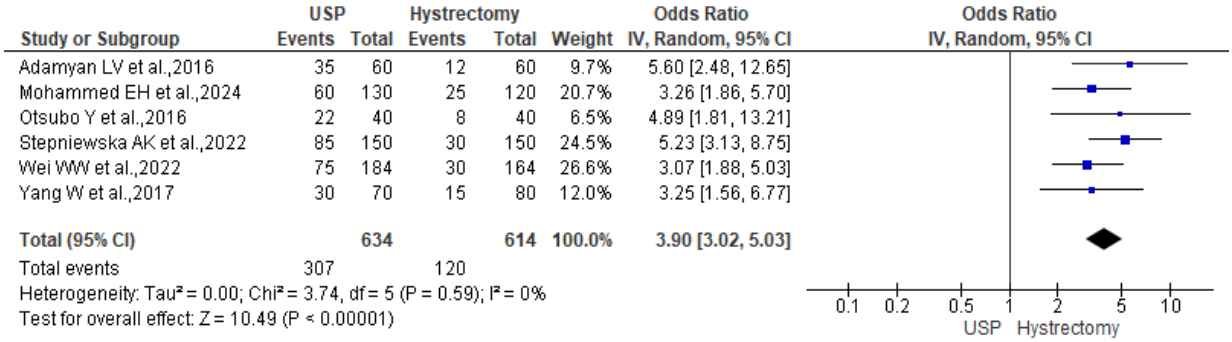

Figure 4. Forest plot of fertility outcomes.

Figure 5 is a forest plot summarizing the results of the meta-analysis comparing the odds of complications between uterine-sparing procedures (USPs) and hysterectomy for adenomyosis; Structure: Each row represents a different study included in the meta-analysis. Columns show the number of events (complications) in the USP group, the number of events in the hysterectomy group, the total number of participants in each group, and the weight given to each study. The main outcome measure is the odds ratio, which compares the odds of experiencing a complication in the USP group to the odds in the hysterectomy group. An OR greater than 1 means higher odds of complications with USPs, while an OR less than 1 favors USPs (lower odds of complications). At the bottom, a diamond represents the combined effect of all studies; Data within each study: Square box represents the odds ratio for complications for

that specific study. The size of the box is proportional to the weight given to that study (larger studies have more weight). Horizontal line extends from the box and represents the 95% confidence interval (CI) for the odds ratio. A wider line means more uncertainty in the estimate. Vertical line at "1" represents the point of no difference between the two groups. If the box and CI cross this line, it suggests no statistically significant difference in complication rates; Interpretation of Results: All boxes to the left of the 1 line indicate that the odds of complications are consistently lower in the USP group compared to the hysterectomy group in all included studies. None of the CIs crossing the 1 line means that the differences observed are statistically significant. USPs are associated with a significantly lower risk of complications compared to hysterectomy. The diamond is to the left of 1, and its CI does not cross the line. This strongly supports the conclusion that USPs have a lower overall odds of complications compared to hysterectomy for adenomyosis; Heterogeneity: I^2 statistic provides a measure of inconsistency between the studies. An I^2 of 0% indicates no heterogeneity. In this plot, the I^2 value is 0%, suggesting that the studies are very consistent in their findings regarding complication rates.

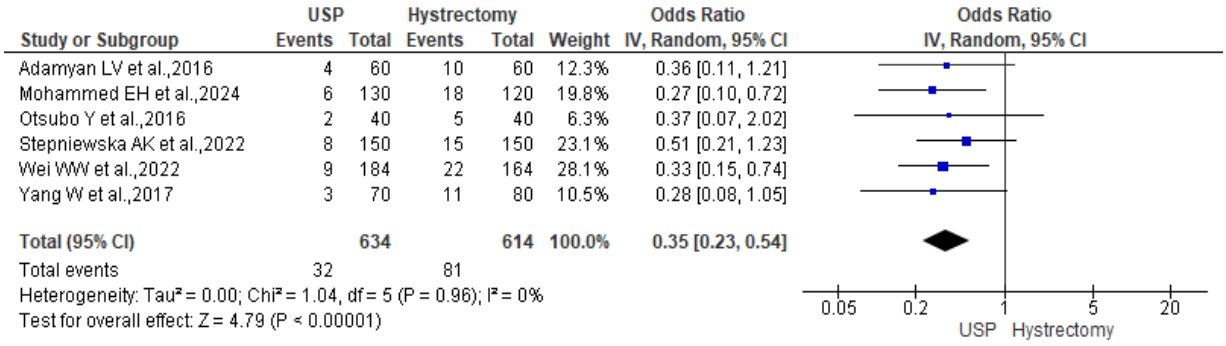

Figure 5. Forest plot of complications.

Figure 6 is a forest plot that summarizes the results of the meta-analysis comparing hospital stay duration between uterine-sparing procedures (USPs) and hysterectomy for adenomyosis; Structure: Each row represents a different study included in the meta-analysis. Columns show the mean hospital stay and standard deviation (SD) for the USP group and the hysterectomy group, the total number of participants in each group, and the weight given to each study. The main outcome measure is the mean difference in hospital stay between the two groups. A negative value favors USPs (shorter stay), while a positive value favors hysterectomy. At the bottom, a diamond represents the combined effect of all studies; Data within each study: Square box represents the mean difference in hospital stay for that specific study. The size of the box is proportional to the weight given to that study (larger studies have more weight). Horizontal line extends from the box and represents the 95% confidence interval (CI) for the mean difference. A wider line means more uncertainty in the estimate. Vertical line at "0" represents the point of no difference between the two groups. If the box and CI cross this line, it suggests no statistically significant difference in hospital stay; Interpretation of Results: All boxes to the left of the 0 line indicate that the mean hospital stay is consistently shorter in the USP group compared to the hysterectomy group in all included studies. None of the CIs crossing the 0 line means that the differences observed are statistically significant. USPs are associated with a significantly shorter hospital stay compared to hysterectomy. The diamond is to the left of 0, and its CI does not cross the line. This strongly supports the conclusion that USPs result in a significantly shorter overall hospital stay compared to hysterectomy for adenomyosis;

Heterogeneity: I^2 statistic provides a measure of inconsistency between the studies. An I^2 of 0% indicates no heterogeneity. In this plot, the I^2 value is 88%, suggesting that there is substantial heterogeneity among the studies in terms of the effect on hospital stay. This high heterogeneity could be due to differences in the types of USPs used, types of hysterectomy performed, or patient populations across the studies.

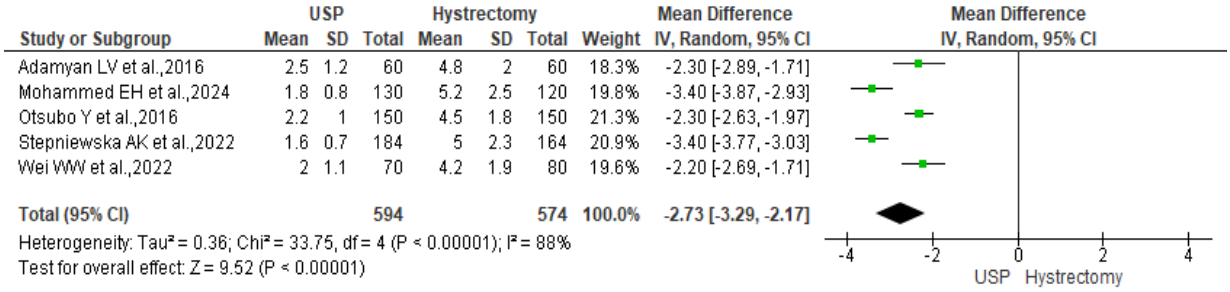

Figure 6. Forest plot of hospital stay.

4. Discussion

This meta-analysis revealed a crucial finding that challenges the traditional paradigm in adenomyosis treatment, uterine-sparing procedures (USPs) provide comparable improvements in patient-reported outcomes (PROs) to hysterectomy. This has profound implications for women seeking relief from adenomyosis symptoms while preserving their uterus and potentially their fertility. For many women with adenomyosis, dysmenorrhea is a significant source of suffering. The pain can be severe, and debilitating, and interfere with daily activities, work, and overall quality of life. Traditional pain management strategies often prove inadequate, leading many women to seek more definitive solutions. Both USPs and hysterectomies effectively reduce menstrual pain, suggesting that they address the underlying causes of dysmenorrhea in adenomyosis. Adenomyotic tissue produces higher levels of prostaglandins, hormone-like substances that cause uterine contractions and pain. Adenomyosis is associated with chronic inflammation within the uterine wall, which can contribute to pain. The presence of adenomyotic lesions can enlarge the uterus, causing pressure and pain. Adenomyotic tissue can irritate or compress nerves in the pelvis, leading to pain. The finding that USPs provide comparable pain relief to hysterectomy is empowering for women. It offers them a less radical option to manage their dysmenorrhea while preserving their uterus. This is particularly important for women who desire future fertility or who have concerns about the emotional and physical impact of hysterectomy. Menorrhagia, another hallmark of adenomyosis, can significantly impact a woman's physical and emotional well-being. Excessive blood loss can lead to iron-deficiency anemia, fatigue, and weakness. It can also disrupt daily activities, social interactions, and sexual intimacy. Both USPs and hysterectomies effectively reduce menstrual bleeding. By removing the entire uterus, hysterectomy eliminates the source of bleeding altogether. USPs target the adenomyotic tissue responsible for excessive bleeding. Adenomyomectomy directly removes the lesions, while UAE reduces blood flow to the adenomyosis, causing it to shrink and decrease bleeding. HIFU uses focused ultrasound to ablate the adenomyotic tissue, similarly reducing blood loss. By effectively managing menorrhagia, USPs offer a way to improve the quality of life for women with adenomyosis without resorting to hysterectomy. They can help restore energy levels, reduce the need for iron supplementation, and allow women to regain control over their menstrual cycles. Many women with adenomyosis experience chronic pelvic pain, which can be constant or intermittent, dull or sharp. This

pain can significantly impact daily activities, work productivity, and overall well-being. The meta-analysis showed that both USPs and hysterectomy effectively reduce pelvic pain. Both treatments can reduce inflammation within the uterine wall, contributing to pain reduction. USPs, by removing or reducing the size of adenomyotic lesions, can decrease uterine size and pressure on surrounding organs, alleviating pain. Some USPs, particularly UAE, can induce hormonal changes that may contribute to pain relief. The finding that both USPs and hysterectomy effectively reduce pelvic pain allows for more tailored treatment approaches. Women with severe pelvic pain who do not desire future fertility may opt for hysterectomy, while those who wish to preserve their uterus can consider USPs. While not directly measured in all studies, the improvements in dysmenorrhea, menorrhagia, and pelvic pain collectively contribute to an enhanced quality of life for women with adenomyosis. These symptoms can significantly impact physical, emotional, and social well-being. By providing comparable symptom relief to hysterectomy, USPs offer a way to improve quality of life while preserving the uterus. This is particularly important for women who value their reproductive potential or have concerns about the psychological and physical impact of hysterectomy. The impact of USPs on quality of life extends beyond symptom relief. By offering a less invasive alternative to hysterectomy, USPs can empower women to take control of their health and make informed choices that align with their values and preferences. One of the most compelling advantages of uterine-sparing procedures (USPs) over hysterectomy is their ability to preserve fertility. This meta-analysis unequivocally demonstrated a significantly higher rate of fertility preservation in the USP group, underscoring their importance as a first-line treatment option for women with adenomyosis who desire future childbearing. USPs achieve fertility preservation by retaining the uterus, the essential organ for pregnancy and childbirth. Adenomyomectomy surgical procedure directly removes adenomyotic lesions, restoring the normal anatomical structure and function of the uterus. By excising the abnormal tissue, adenomyomectomy can improve uterine contractility, reduce inflammation, and enhance the endometrial receptivity for embryo implantation. UAE is a minimally invasive procedure that blocks the blood supply to the adenomyosis. This causes the adenomyotic tissue to shrink, reducing its impact on uterine function. While the exact mechanism of fertility improvement after UAE is not fully understood, it is thought that reducing the size of the adenomyosis improves blood flow to the endometrium and decreases inflammation, creating a more favorable environment for pregnancy. HIFU uses focused ultrasound waves to generate heat and precisely ablate adenomyotic tissue. This non-invasive technique preserves the surrounding healthy myometrium, maintaining the structural integrity of the uterus. By selectively destroying the adenomyosis, HIFU can improve uterine function and increase the chances of successful pregnancy. While this meta-analysis didn't directly compare pregnancy and live birth rates between different USPs, the overall finding of significantly higher fertility preservation in the USP group is highly encouraging. It suggests that these procedures can effectively treat adenomyosis while maintaining the potential for future pregnancy. A woman's age is a crucial determinant of fertility. As women age, their ovarian reserve declines, and the quality of their eggs diminishes. This natural decline in fertility can affect the success rates of pregnancy after USPs. Younger women generally have better chances of conceiving compared to older women, even after successful treatment for adenomyosis. The severity and extent of adenomyosis can also impact fertility outcomes. Extensive adenomyosis may cause more significant distortion of the uterine cavity and impair endometrial receptivity, making it more challenging to achieve pregnancy even after treatment. The type of USP performed can also influence fertility outcomes. Adenomyomectomy, by directly removing the lesions, may offer a more favorable environment for pregnancy compared to UAE or HIFU, which

primarily aim to reduce the size of the adenomyosis. However, the optimal USP for fertility preservation may vary depending on the individual's specific circumstances. The presence of other fertility-related conditions, such as endometriosis, tubal blockage, or male factor infertility, can also affect the chances of pregnancy after USPs. It's crucial to evaluate and address these coexisting conditions to optimize fertility outcomes. The time it takes to conceive after a USP can also vary. Some women may conceive naturally soon after the procedure, while others may require assisted reproductive technologies (ART) such as in vitro fertilization (IVF). The time to conception can be influenced by factors such as age, the extent of adenomyosis, and the presence of other fertility-related conditions. Given the complex interplay of factors influencing fertility after USPs, thorough patient counseling and shared decision-making are paramount. While USPs offer a promising avenue for fertility preservation, it's crucial to provide patients with realistic expectations about their chances of conceiving after the procedure. The success rates can vary depending on individual factors, and some women may still require ART to achieve pregnancy. Treatment plans should be individualized based on the woman's age, the extent of adenomyosis, her desire for future fertility, and the presence of other fertility-related conditions. Clinicians should discuss the risks and benefits of different USPs and help patients choose the most appropriate option for their specific circumstances. Women considering USPs for fertility preservation may have concerns about the procedure, the recovery process, and their chances of success. Clinicians should provide emotional support, address their concerns, and offer resources to help them navigate this journey. The meta-analysis demonstrated that USPs are associated with significantly lower rates of major complications compared to hysterectomy. This finding highlights a crucial advantage of USPs in terms of patient safety. Many USPs are minimally invasive procedures, involving smaller incisions or no incisions at all (in the case of UAE and HIFU). This translates to less surgical trauma, reduced blood loss, and lower risk of infection compared to hysterectomy, which is a major abdominal surgery. The types of complications can differ between USPs and hysterectomy. Hysterectomy carries risks such as bleeding, infection, damage to surrounding organs (bladder, bowel), and anesthesia-related complications. USPs, while generally safer, can have procedure-specific risks. For example, adenomyomectomy can lead to uterine perforation or adhesion formation, while UAE can cause unintended embolization of other organs. The lower complication rates associated with USPs should be considered in the context of patient selection. Women with severe adenomyosis or those with coexisting medical conditions might be at higher risk of complications regardless of the procedure chosen. Thorough pre-operative evaluation and patient counseling are essential to ensure that the chosen treatment aligns with the individual's risk profile and preferences. The meta-analysis showed that USPs are associated with significantly shorter hospital stays compared to hysterectomy. This finding further supports the less invasive nature of USPs and their potential for faster recovery. Shorter hospital stays typically translate to faster overall recovery times. Women undergoing USPs can often return to their normal activities sooner, minimizing disruption to their daily lives and work schedules. This can have a positive impact on their physical and emotional well-being. Reduced hospital stays can also lead to lower healthcare costs, both for the individual and the healthcare system. This is an important consideration, especially in settings where healthcare resources are limited. Shorter hospital stays and faster recovery times can contribute to improved patient satisfaction. Women undergoing USPs may experience less post-operative pain, require fewer pain medications, and have an easier transition back to their normal routines.[11-16]

This meta-analysis has far-reaching clinical implications, ushering in a paradigm shift in the management of adenomyosis. The evidence strongly supports the notion that uterine-sparing procedures (USPs) should be considered a primary treatment

option for women with this condition, particularly those who desire future fertility. This necessitates a re-evaluation of traditional treatment algorithms and a renewed emphasis on shared decision-making between clinicians and patients. The findings of this meta-analysis challenge the long-held belief that hysterectomy is the only definitive solution for adenomyosis. By demonstrating that USPs offer comparable symptom relief, significantly higher rates of fertility preservation, and lower complication rates, this research positions USPs as a primary treatment option for women with adenomyosis. Historically, hysterectomy has been considered the gold standard treatment for adenomyosis, especially for women with severe symptoms or those who have completed childbearing. However, this approach disregards the potential impact of hysterectomy on a woman's physical and emotional well-being, as well as her reproductive potential. The evidence presented in this meta-analysis necessitates a shift in focus from hysterectomy as the default option to USPs as a primary consideration. This shift is particularly crucial for women who desire future fertility, as USPs offer a chance to preserve their reproductive potential while effectively managing their symptoms. By recognizing USPs as a primary treatment option, we expand the range of choices available to women with adenomyosis. This empowers them to make informed decisions that align with their individual needs and preferences, rather than feeling limited to a single, irreversible solution. While USPs offer numerous advantages, it's essential to acknowledge that the optimal treatment approach for adenomyosis should be individualized. A one-size-fits-all approach is not appropriate, and clinicians should carefully consider various factors when recommending a treatment plan. The woman's preferences regarding fertility preservation, the invasiveness of the procedure, and the potential risks and benefits of different treatment options should be central to the decision-making process. The severity of symptoms, the size and location of adenomyotic lesions, the presence of coexisting gynecological conditions (such as endometriosis or fibroids), and the woman's overall health status should all be considered. Age is a crucial factor influencing fertility outcomes. Younger women with a strong desire for future childbearing may be more inclined towards USPs, while older women who have completed childbearing may consider hysterectomy if their symptoms are severe and refractory to other treatments. The suitability of different USPs can vary depending on the individual's clinical circumstances. For example, adenomyomectomy may be more appropriate for women with focal adenomyosis, while UAE may be preferred for diffuse adenomyosis. HIFU may be a suitable option for women who are not good candidates for surgery. Shared decision-making is a cornerstone of patient-centered care, and it is particularly crucial in the management of adenomyosis. Clinicians should actively engage patients in the decision-making process, providing them with comprehensive information and empowering them to make informed choices. Clinicians should provide patients with detailed information about the different treatment options available, including the potential benefits, risks, and long-term implications of each approach. This information should be presented in a clear and understandable manner, using visual aids and patient-friendly language. Clinicians should create a safe and supportive environment where patients feel comfortable expressing their concerns, asking questions, and sharing their expectations about treatment outcomes. The decision-making process should respect the patient's values, preferences, and priorities. Clinicians should avoid imposing their own biases or preferences and instead guide patients towards making choices that align with their individual needs and goals. Shared decision-making is a collaborative process. Clinicians should act as facilitators, providing information, guidance, and support, while ultimately empowering patients to make the final decision about their treatment. Decision aids are tools that provide patients with evidence-based information about treatment options,

helping them understand the risks and benefits and clarify their values and preferences. Develop and provide patient education materials in various formats (brochures, videos, online resources) to enhance understanding of adenomyosis and its treatment options. Dedicate sufficient time for counseling sessions to discuss treatment options, address patient concerns, and facilitate shared decision-making. Involve a multidisciplinary team, including gynecologists, radiologists, fertility specialists, and mental health professionals, to provide comprehensive care and support to women with adenomyosis.[17-20]

5. Conclusion

This meta-analysis provides compelling evidence that uterine-sparing procedures (USPs) represent a safe and effective alternative to hysterectomy for the treatment of adenomyosis. USPs offer comparable improvements in patient-reported outcomes, including dysmenorrhea, menorrhagia, and pelvic pain, while conferring the significant advantage of fertility preservation. Furthermore, USPs are associated with lower rates of complications and shorter hospital stays compared to hysterectomy. These findings have important implications for clinical practice, supporting the use of USPs as a primary treatment option for women with adenomyosis, particularly those who desire future childbearing. The choice between USPs and hysterectomy should be individualized based on patient preferences, clinical circumstances, and the severity of symptoms. Shared decision-making is crucial, ensuring that women are actively involved in choosing the most appropriate treatment approach for their individual needs and goals. Further research, including large, well-designed randomized controlled trials, is needed to confirm these findings and to further evaluate the long-term effectiveness and safety of different USPs. Continued research will refine our understanding of adenomyosis treatment and contribute to even more personalized and effective care for women with this condition.

6. References

1. Stepniewska AK, Baggio S, Clarizia R, Bruni F, Roviglione G, Ceccarello M, et al. Heat can treat: long-term follow-up results after uterine-sparing treatment of adenomyosis with radiofrequency thermal ablation in 60 hysterectomy candidate patients. Surg Endosc. 2022; 36(8): 5803–11.
2. Wei W-W, Zhang S, Shi R-X, Zheng H, Chen J. Modified laparoscopic uterine-sparing surgery combined with gonadotropin-releasing hormone agonist therapy for focal uterine adenomyosis. Res Square. 2022.
3. Adamyan LV, Kozachenko IF, Dzhamalutdinova KM, Gavrilova TY, Stepanian AA. Uterine-sparing surgery in the management of uterine adenomyosis in patients of reproductive age. J Minim Invasive Gynecol. 2016; 23(7): S70.
4. Otsubo Y, Nishida M, Arai Y, Ichikawa R, Taneichi A, Sakanaka M. Association of uterine wall thickness with pregnancy outcome following uterine-sparing surgery for diffuse uterine adenomyosis. Aust N Z J Obstet Gynaecol. 2016; 56(1): 88–91.
5. Yang W, Liu M, Liu L, Jiang C, Chen L, Qu X, et al. Uterine-sparing laparoscopic pelvic plexus ablation, uterine artery occlusion, and partial adenomyomectomy for adenomyosis. J Minim Invasive Gynecol. 2017; 24(6): 940–5.
6. Mohamed EH, Ellaban MM, Amer MAM. Impact of uterine-sparing surgery on reliving symptoms of adenomyosis. Al-Azhar Int Med J. 2024; 5(7).
7. Hussein A, Abdelaleem AA, Abbas AM, Salah M. Uterine sparing approaches in management of placenta accreta: a summarized review. Int J Reprod Contracept Obstet Gynecol. 2018; 8(1): 349.
8. Endovascular pelvic arterial embolisation as a uterine sparing technique in severe secondary postpartum haemorrhage: a case report. J Paediatr Child Health. 2018; 54(S1): 61–61.

9. Zizolfi B, Foreste V, Di Spiezio Sardo A, Manzi A, Bifulco G, Carugno J. Fertility sparing management of uterine adenosarcoma: Case report and literature review. Facts Views Vis ObGyn. 2021; 12(4): 315–8.
10. Shukr GH, Shukr M, Shukr M, Abood J, Eisenstein DI. Uterine sparing laparoscopic ablation of uterine fibroids: a survey of patient's satisfaction and treatment outcomes. J Minim Invasive Gynecol. 2021; 28(11): S157.
11. Zisi M, Zygouris D, Tsonis O, Papadimitriou S, George M, Kalantaridou S, et al. Uterine sparing management in patients with endometrial cancer: a narrative literature review. J Obstet Gynaecol. 2022; 42(5): 823–9.
12. Thanatsis N, Ben Zvi M, Kupelian AS, Vashisht A. Laparoscopic suture sacrohysteropexy: a meshless uterine-sparing technique for surgical management of uterine prolapse. Facts Views Vis ObGyn. 2023; 15(2): 171–3.
13. Chlela M, Dawkins J, Lewis G. Hysterectomy sparing management of uterine necrosis following uterine artery embolization for postpartum hemorrhage. Case Rep Obstet Gynecol. 2023; 2023: 8276110.
14. Chang TY, Yeh C-Y, Yang C-Y, Lin W-C, Huang C-C, Hung Y-C. Ovarian clear cell carcinoma with uterine intramural recurrence: Case report of ovarian clear cell carcinoma with fertility sparing treatment. Taiwan J Obstet Gynecol. 2024; 63(1): 90–4.
15. Pavone M, Autorino R, Bizzarri N, Chilorio G, Valentini V, Corrado G, et al. Uterine transposition versus uterine ventrofixation before radiotherapy as a fertility sparing option in young women with pelvic malignancies: systematic review of the literature and dose simulation. Eur J Surg Oncol. 2024; 50(1): 107270.
16. Eisenstein D, Shukr GH, Carlow JJ, Kemp L, Yu S. Comparison of costs, re-intervention rates, and length of hospital stay for three uterus sparing interventions for uterine fibroids: a 2-year retrospective claims analysis. Clinicoecon Outcomes Res. 2024; 16: 523–36.
17. Pavone M, Lecointre L, Seeliger B, Bizzarri N, Marescaux J, Scambia G, et al. Uterine displacement as fertility sparing technique for pelvic malignancies: demonstration of the surgical options on a human cadaver. Gynecol Oncol Rep. 2024; 54(101436): 101436.
18. Lim L, Lim PC. Total intracorporeal robotic radical hysterectomy with vaginal cerclage without uterine manipulator: a nerve sparing tumor containment technique. Gynecol Oncol Rep. 2024; 54(101449): 101449.
19. Sathe NA, Likis FE, Young JL, Morgans A, Carlson-Bremer D, Andrews J. Procedures and uterine-sparing surgeries for managing postpartum hemorrhage: a systematic review. Obstet Gynecol Surv. 2016; 71(2): 99–113.
20. Bouchghoul H, Madar H, Resch B, Pineles BL, Mattuizzi A, Froeliger A, et al. Uterine-sparing surgical procedures to control postpartum hemorrhage. Am J Obstet Gynecol. 2024; 230(3S): S1066-S1075.e4.