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Review

Is vaginal hysterectomy outdated? A systematic overview of reviews with future perspectives

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ABSTRACT

Background: Hysterectomy is the second most common surgical procedure in women. Vaginal hysterectomy (VH) historically represents the preferred approach for benign conditions due to its minimally invasive nature. However, with advances in endoscopic techniques, the role of VH has been questioned. This review aims to systematically summarize existing evidence coming from currently available systematic reviews and meta-analyses which compare VH with other techniques such as laparotomy, laparoscopy and robotics.
Methods: We systematically searched Pubmed, Scopus, EMBASE and Cochrane library from 1st January 1996 to 31st July 2024. We conducted a systematic overview of reviews to compare VH with abdominal, laparoscopic, and robotic hysterectomy, focusing on procedural parameters, complications and patient outcomes. The quality of evidence and certainty of findings were critically assessed.
Results: Our findings suggest that VH has shorter operative time compared to all the other approaches. Compared to laparotomy, VH is associated with reduced time from hospital admission to recovery. No differences were found concerning intra- and post-operative complications demonstrating VH as a safe superimposable technique. The quality of the evidence ranged from critical to moderate, with high heterogeneity among the studies, requiring cautious interpretation.
Conclusion: VH offers reduced operating times and faster recovery in comparison to alternative techniques, with comparable complication rates. These data support the clinical relevance of VH as a valuable option for benign gynecological conditions. However, a nuanced comparison with alternative and innovative techniques are essential for personalized surgical decisions and a potential renaissance of this approach.

1. Introduction and background

Hysterectomy is the second most common surgical procedure that women undergo worldwide following cesarean section. According to the Centers for Disease and Prevention (CDC), each year 600,000 hysterectomies are performed in the United States. Nowadays, hysterectomy is performed using diverse and advanced techniques, including abdominal (laparotomic) hysterectomy (AH), laparoscopic hysterectomy (LH), robotic hysterectomy (RH), and vaginal approaches. Most often, the leading indications for hysterectomy include a variety of benign conditions such as leiomyomas, abnormal uterine bleeding, endometriosis, and pelvic organ prolapse. Described for the first time by Langenbeck in 1813 [1], vaginal hysterectomy (VH) can be considered the first "minimally invasive" approach to hysterectomy, as it requires no incision in the abdominal wall, long before laparoscopy and other minimally invasive approaches were born and popularized. Over the last three decades, VH has inevitably lost its vogue in the gynaecologic panorama due to a growing enthusiasm for endoscopic surgery, which is inarguably easier to teach to future generations of surgeons. Recent efforts of societies, such as The American College of Obstetricians and

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Gynecologists [2] and the American Association of Gynecologic Laparoscopists [3] have verbalized that VH should still be considered the approach of choice in the treatment of benign diseases whenever feasible, and should be the preferred therapeutic strategy among all minimally invasive approaches [4,5].

Several systematic reviews and meta-analyses have confirmed that VH shows good results in term of safety and efficacy when compared to other surgical approaches and techniques, despite some conflicting results. Therefore, the debate persists regarding which minimally invasive method is superior in term of offering the greatest benefits to patients and surgeons.

To summarize the sometimes-discordant evidence provided by published literature, we performed an umbrella review (or systematic overview of reviews), assessing the methodological quality of available systematic reviews and meta-analyses while providing a summary of their evidence. Our umbrella review gathers existing meta-analysis to analyze several intra and postoperative outcomes that compare VH to other existing surgical approaches, providing a comprehensive overview of the existing literature.

2. Materials and methods

This study followed the methodological guidelines for umbrella reviews outlined in the Preferred Reporting Items for Overviews of Reviews (PRIOR) [6] statement. Additionally, Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [7] were applied for the conduct and reporting of data. AMSTAR-2 checklist [8] was utilized to assess quality of evidence of included studies.

To define the scope of the overview using the population, intervention, comparison and outcome (PICO) process [9], the following research questions were addressed "how does vaginal hysterectomy compare to laparoscopic and/or abdominal and/or robotic hysterectomy in terms of safety, satisfaction and cost?". A literature search for articles indexed in PubMed, Scopus, EMBASE, Cochrane Library electronic databases was performed to identify original papers evaluating vaginal hysterectomy in comparison to the aforementioned approaches using the following terms: 'vaginal' AND 'hysterectomy' or 'hysterectomy, abdominal' or 'hysterectomy, vaginal' or 'hysterectomy -laparoscopic' or 'hysterectomy -laparoscopically assisted vaginal' or 'hysterectomy techniques' or 'laparoscopic assisted vaginal hysterectomy' or 'laparoscopic hysterectomy' or 'LAVH' or 'TVH' or 'TLH' or 'abdominal hysterectomy' or 'robotic hysterectomy' or 'laparotomy'. Articles selection was refined based on the PICOS criteria: Systematic reviews that fulfilled the following PICO criteria were eligible for inclusion:

- Population (P): patients who underwent hysterectomy for benign gynecological conditions
- Intervention (I): Vaginal Hysterectomy
- Comparators (C): Abdominal Hysterectomy, Laparoscopic Hysterectomy including Laparoscopically Assisted Vaginal Hysterectomy, Robotic Hysterectomy.
- Outcomes of interest (O): Operative time, intraoperative complications, postoperative complications, time to recovery.
- The study design (S) included only meta-analyses.

The selected articles were required to compare vaginal hysterectomy with other existing surgical techniques in individuals aged 18 and older. We excluded non-systematic reviews such as narrative or scoping reviews, systematic reviews without meta-analyses, original articles, editorials, and experimental studies. All non-English language studies were excluded (Fig. 1).

Two authors (RO and SM) independently analyzed the title and abstracts of citations and the full texts of potentially eligible publications issued between 1st January 1996 and 31st July 2024. After the study selection, relevant data was collected and reported in this article. The analysis of screening and inclusion criteria, methodological quality with risk of bias assessments for all articles was performed independently by the two reviewers mentioned above, with a process for resolving discrepancies.

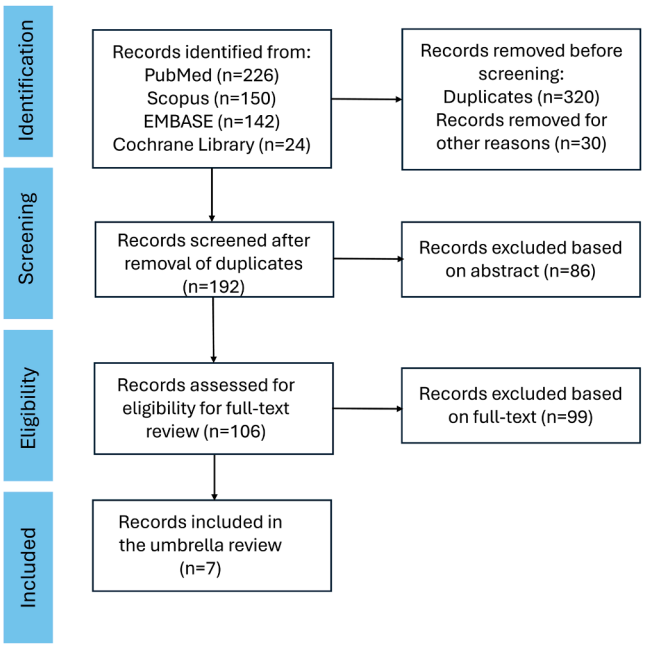

Fig. 1. PRISMA flow diagram of review selection
Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) flow diagram of systematic review selection process for the overview of reviews.

The quality of each study was assessed using the AMSTAR-2 tool, a 16-item checklist used to critically rate the quality of an individual systematic review as critically low, low, moderate, or high. This was not taken as an inclusion criterion but was presented alongside the descriptive analysis of the evidence to allow the reader to form a judgement about the quality of the evidence available.

Outcomes from the various meta-analyses were independently extracted, including first author name and year of publication, number and type of articles reviewed, number of enrolled patients for each report. Furthermore, we reported pooled outcome measures with 95 % confidence intervals (CI), assessed statistical heterogeneity when available, and evaluated possible publication bias.

When reviewing systematic reviews, there is a risk that individual studies may appear in multiple reviews, potentially giving undue weight to certain studies and biasing the results. Being aware of that, we used a citation matrix and the Corrected Covered Area (CCA) method. Overlap was considered slight as the CCA was 0–5 % moderate if the CCA was 6–10 %, high if the CCA was 11–15 % and very high in case of CCA > 15 %. In case of high or very high overlap, we only included the most recently published review, while excluding overlapping records.

3. Results

3.1. Screening process

An extensive search retrieved a total of 542 records. During the initial screening, 320 articles were excluded due to duplication, and 30 were excluded for not meeting the inclusion criteria before abstract screening. Eighty-six articles were excluded based on abstract revision. Consequently, only 106 articles remained eligible for full-text review. After screening records, 7 systematic reviews with meta-analyses were included: Azadi et al. [10], Gendy et al. [11], Guan et al. [12], Lee et al. [13], Lenfant et al. [14], Pickett et al. [15], Sloth et al. [16], Guo et al.

[17]. (Fig. 1). Most systematic reviews included only randomized controlled trials, except two reviews [14,16] that included observational and database studies. The characteristics of the systematic reviews are summarized in Table 1.

For each of the included meta-analyses, we extracted data for the outcomes of interest. All included reviews compared intra- and post-operative outcomes between VH and either AH, LH, or RH in patients with benign gynecological conditions. Reviews comparing VH to other techniques (such as vNOTES) were excluded because they did not meet the inclusion criteria.

The 7 meta-analyses were published between 2011 and 2024, had 5 to 78 primary studies included, and had total sample sizes of 629 to 7640. As an isolate exception, one study [14] comparing RH to other techniques including VH had a very high sample size (189237 patients), as it involved large database studies. We present the analyzed outcomes comparing intra- and post- operative variables between VH and AH, LH and RH. Table 2 provides a summary of data for each outcome.

3.2. Operative time

Overall, operative time seem to be shorter for VH compared with laparoscopic and robotic surgery.

Five out of 5 included meta-analysis reported that VH had a significantly shorter OT compared with LH (either TLH, LAVH or unspecified LH). One meta-analysis compared VH to RH [14] also showing a shorter time for VH. Similarly, only one [15] meta-analysis provided data comparing VH to AH in term of OT, but no statistically significant difference was found. All the included meta-analyses had very high I^2 values, indicating considerable heterogeneity.

3.3. Intra-operative complications

Two reviews reported on the incidence of overall complications between VH and LH [12,17] and one [13] compared it with RH. None of the reviews found a significant difference in the incidence overall complications, and all the meta-analyses had low I^2 values, indicating low heterogeneity.

Four reviews reported on the incidence of bleeding. Three of these compared VH to LH in term of OR with 95 % CI, one of which found a significant difference favouring VH [10], although a high heterogeneity was reported. One review [13] showed significantly lower bleeding in term of estimated blood loss in robotic approach in comparison to VH, although heterogeneity was not specified. The difference in risk of unintended laparotomy was reported by 5 reviews, 4 comparing VH to LH [10,11,14,17], and 1 to RH [14]. No statistically significant difference was reported in all 5 meta-analyses. The statistical heterogeneity was low in all reviews except for the one comparing VH to robotics. Regarding intraoperative risks to adjacent organs, one Cochrane meta-analysis [15] reported no difference in bowel injuries between LH and VH. No difference in risk of urinary tract injury was found in term of OR in 3 reviews comparing VH to LH [10,11,15] and in one comparing VH to AH [15], with a low heterogeneity.

3.4. Post-operative complications

Four reviews compared odds of transfusions in the postoperative period among techniques. Two [10,15] found no differences in transfusion rate between vaginal and laparoscopic approach, with low heterogeneity. One [15] found no difference between VH and AH, and one [14] found similar results when comparing VH to RH, although with higher I^2 values. Four different papers [10–12,15] found no differences in the rate of febrile/unspecified infection, and the review by Pickett [11,15] found no differences when comparing AH to VH, with low heterogeneity of all but one studies [11]. Similarly, no difference was found by Pickett [15] in the rate of vaginal cuff infections when comparing the vaginal approach to both LH and AH (I^2=0 %). The only statistical difference was found in the OR of urinary tract infections by one meta-analysis [10], favouring vaginal hysterectomy in comparison to laparoscopy.

3.5. Recovery

Hospital stay length was evaluated by 6 different reviews comparing VH to LH [10,11,13,15,16]. Of these, two [15,16] favoured the vaginal approach, with high heterogeneity, and one [6] showed shorter hospital stay in the laparoscopic group. Furthermore, when comparing VH to RH, a shorter hospital stay was found for robotics in one meta-analysis [14], although with a high heterogeneity. Differently, the only report assessing differences between AH and VH favoured vaginal approach [15] in both hospital stay and in return to normal activities. One [10] out of three [14,15] meta-analyses found differences in term of return to normal activities, in favour of VH when compared to LH.

3.6. Descriptive analysis

The high level of heterogeneity in the patient population and procedure precluded meta-analysis. We conducted a descriptive analysis and tabulated the results by outcome. To visually summarize our results,

Table 1
Characteristics of the included reviews. *RCT* randomized controlled trial, *AMSTAR-2* Assessing the Methodological Quality of Systematic Reviews, *TLH* total laparoscopic hysterectomy, *VH* vaginal hysterectomy, *RH* robotic hysterectomy, *AH* abdominal hysterectomy, *LAVH* laparoscopically assisted vaginal hysterectomy.

Review	Comparisons	Database searched	Studies Included		Participants, n	Risk of Bias Assessment	AMSTAR-2 Quality assessment
			RCT	No RCT			
Guan 2024 [12]	TLH vs VH	7	78	0	7640	High	Critically Low
Azadi 2023 [10]	VH vs LH	5	22	0	2408	Low	Moderate
Lenfant 2023 [14]	RH vs VH	3	4	6	189,237	High	Critically Low
Pickett 2023 [15]	VH vs AH	7	12	0	1046	Low	Moderate
	LH (LAVH or TLH or unspecified LH)	7	22	0	2135		
Lee 2019 [13]	VH vs LH (LAVH or TLH or unspecified VH)	3	18	0	1618 (VH *n* = 677, LH *n* = 941)	High	Low
Sloth 2017 [16]	VH vs LH (LAVH or TLH or common LH)	12	15	7	NS	High	Critically Low
Gendy 2011 [11]	TLH vs VH	4	5	0	663 (VH *n* = 331, TLH *n* = 332)	High	Low

Table 2
Summary of the outcomes for each included meta-analyses. *MD* mean difference, *WMD* weighted mean difference, *OR* odd-ratio, *RR* risk-ratio, *NS* non specified, *TLH* total laparoscopic hysterectomy, *LH* laparoscopic hysterectomy, *VH* vaginal hysterectomy, *RH* robotic hysterectomy, *AH* abdominal hysterectomy, *LAVH* laparoscopically assisted vaginal hysterectomy, *VAS* visual analogue scale.

Review	Comparisons	Studies Included	Patients	Estimation measure	Estimation	95 % CI	p-value	Favors	I^2
Operative Time									
Azadi 2023 [10]	VH vs LH	23	2314	MD	−34.94	−42.39 to −27.49	<0.001	Vaginal	97 %
Lenfant 2023 [14]	RH vs VH	5	800,077	MD	42.87	22.94 to 62.8	<0.001	Vaginal	100 %
Pickett 2023 [15]	VH vs AH	7	594	MD	−19.02	46.80 to 8.75	0.18	NS	99 %
Pickett 2023 [15]	LH vs VH	3	192	MD	41.89	−5.52 to 89.31	<0.001	Vaginal	98 %
Lee 2019 [13]	VH vs LH	18	2011	WMD	−34.01	−43.54 to −24.48	<0.001	Vaginal	98 %
Sloth 2017 [16]	VH vs LH	NS	1801	MD	−41	28 to 53	0.1	Vaginal	95 %
Gendy 2011 [11]	TLH vs VH	5	663	WMD	29.31	13.33 to 45.30	<0.001	Vaginal	100 %
Overall Complications									
Guan 2024 [12]	TLH vs VH	11	NS	OR	0.79	0.5 to 1.25	0.47	NS	0 %
Lenfant 2023 [14]	RH vs VH	6	90,293	OR	0.7	0.4 to 1.23	0.22	NS	96 %
Lee 2019 [13]	VH vs LH	18	1942	RR	1.1	0.85 to 1.45	0.46	NS	25 %
Bleeding									
Azadi 2023 [10]	VH vs LH	18	1352	MD	−68	−104.29 to −31.7	<0.001	Vaginal	95 %
Lenfant 2023 [14]	RH vs VH	4	6661	MD	−71.18	−85.15 to −54.22	<0.001	Robotics	NS
Pickett 2023 [15]	LH vs VH	4	806	OR	1.36	0.29 to 6.39	0.69	NS	0 %
Lee 2019 [13]	VH vs LH	12	1942	MD	−35.91	−102.26 to 30.43	0.29	NS	97 %
Gendy 2011 [11]	TLH vs VH	3	663	WMD	−42.24	−101.18 to 16.71	0.16	NS	48 %
Unintended Laparotomy									
Azadi 2023 [10]	VH vs LH	9	1090	OR	0.69	0.37 to 1.28	0.24	NS	11 %
Lenfant 2023 [14]	RH vs VH	6	89,266	OR	1.23	0.05 to 33.38	0.9	NS	99 %
Pickett 2023 [15]	LH vs VH	4	1414	OR	1.4	0.72 to 2.71	0.32	NS	0 %
Lee 2019 [13]	VH vs LH	12	2011	RR	1.16	0.6 to 2.26	0.66	NS	0 %
Gendy 2011 [11]	TLH vs VH	3	NS	OR	1.26	0.49 to −3.27	0.63	NS	0 %
Bowel Complication Rate									
Pickett 2023 [15]	LH vs VH	6	986	OR	3.26	0.13 to 82.16	0.47	NS	NA
Urinary Tract Complication Rate									
Azadi 2023 [10]	VH vs LH	13	1616	OR	1.22	0.6 to 2.46	0.58	NS	0 %
Pickett 2023 [15]	VH vs AH	15	1594	OR	1.73	0.65 to 4.63	0.27	NS	0 %
Pickett 2023 [15]	LH vs VH	15	1536	OR	1.01	0.23 to 4.38	0.84	NS	0 %
Gendy 2011 [11]	TLH vs VH	5	663	OR	1.89	0.39 to −9.21	0.43	NS	45 %
Transfusion Rate									
Azadi 2023 [10]	VH vs LH	13	1406	OR	0.84	0.51 to 1.37	0.48	NS	0 %
Lenfant 2023 [14]	RH vs VH	4	85,630	OR	0.41	0.15 to 1.16	0.09	NS	85 %
Pickett 2023 [15]	VH vs AH	9	852	OR	0.78	0.44 to 1.38		NS	15 %
Pickett 2023 [15]	LH vs VH	14	1586	OR	1.25	0.76 to 2.06	0.37	NS	0 %
Hospital Stay									
Azadi 2023 [10]	VH vs LH	22	1655	MD	−0.17	−0.43 to 0.09	0.2	NS	96 %
Lenfant 2023 [14]	RH vs VH	5	88,799	MD	−0.39	−0.7 to −0.08	0.01	Robotics	99 %
Pickett 2023 [15]	VH vs AH	7	570	MD	−1.57	−2.11 to −1.03	<0.001	Vaginal	96 %
Pickett 2023 [15]	LH vs VH	12	912	MD	0.65	0.45 to 0.85	<0.001	Vaginal	82 %
Lee 2019 [13]	VH vs LH	11	1618	WMD	−6.57	−18.65 to 5.5	0.29	NS	99 %
Sloth 2017 [16]	VH vs LH	9	1424	MD	−0.4	0 to 0.9	<0.001	Vaginal	NS
Gendy 2011 [11]	TLH vs VH	4	NS	WMD	−0.62	−0.89 to −0.35	<0.001	Laparoscopy	NS
Post-operative VAS scale at 24H									
Azadi 2023 [10]	VH vs LH	5	493	MD	0.24	−0.74 to 1.22	0.63	NS	87 %
Lee 2019 [13]	VH vs LH	4	NS	MD	−0.53	−0.7 to −0.35	<0.001	Vaginal	0 %
Return to normal activities									
Azadi 2023 [10]	VH vs LH	6	378	MD	−2.45	−4.7 to −1.93	0.03	Vaginal	30 %
Pickett 2023 [15]	VH vs AH	4	274	MD	−10.91	−17.95 to −3.87	0.002	Vaginal	67 %
Pickett 2023 [15]	LH vs VH	3	238	MD	−1.06	−4.18 to 2.05	0.5	NS	0 %
Lee 2019 [13]	LH vs VH	3	NS	WMD	0.65	−6.01 to 7.3	0.85	NS	92 %
Febrile/ unspecified infection									
Guan 2024 [12]	TLH vs VH	5	NS	OR	2.45	0.77 to 7.81	0.79	NS	0 %
Azadi 2023 [10]	VH vs LH	15	1501	OR	1.48	0.98 to 2.23	0.06	NS	0 %
Pickett 2023 [15]	VH vs AH	6	593	OR	0.59	0.35 to 1.01	0.06	NS	6 %
Pickett 2023 [15]	LH vs VH	13	1508	OR	0.81	0.53 to 1.24	0.34	NS	0 %
Gendy 2011 [11]	TLH vs VH	5	663	OR	0.87	0.38 to −2	0.74	NS	98 %
Urinary Tract Infection									
Azadi 2023 [10]	VH vs LH	7	459	OR	0.3	0.10 to 0.87	0.03	Vaginal	0 %
Pickett 2023 [15]	VH vs AH	5	350	OR	0.52	0.14 to 1.97	0.23	NS	0 %
Pickett 2023 [15]	LH vs VH	5	328	OR	2.12	0.6 to 7.5	0.24	NS	0 %
Vaginal Cuff Infection									
Pickett 2023 [15]	VH vs AH	3	216	OR	3.14	0.48 to 20.55	0.23	NS	0 %
Pickett 2023 [15]	LH vs VH	4	276	OR	0.98	0.22 to 4.39	0.98	NS	0 %

we utilized a color-coded method to present the descriptors (Fig. 2): green indicates a positive effect favouring VH, red indicates a negative effect, showing a statistically significant finding favouring the compared technique (AH, LH or RH, respectively), and yellow represents a neutral outcome, meaning no statistically significant difference was found. It is crucial to specify that statistical significance does not necessarily imply clinical relevance. This mapping method enabled us to visually display the strength and volume of the literature-based evidence. Since we did not synthesize evidence, we did not conduct sensitivity analyses to assess the robustness of results. However, we provided information on the heterogeneity of each meta-analysis in Table 2.

3.7. Summary of results

Although there are multiple published reports to assess the preferred approach to perform a hysterectomy, the current role of VH in this evolving panorama has yet to be established.

Systematic reviews and meta-analyses can be considered among the strongest sources of clinical evidence to create recommendations for medical practice. Our overview offers an outline of the clinical outcomes of vaginal hysterectomy compared to other available routes and presents a summary of the evidence base to support the decision-making process for clinicians.

Our results suggest that VH, as compared to the abdominal approach, is associated with reduced time from hospital admission to recovery. Regarding operating time, vaginal route seems to be the fastest approach when compared to robotics and laparoscopy. Concerning intra- and post-operative complications, VH represents a safe option with superimposable complication rates.

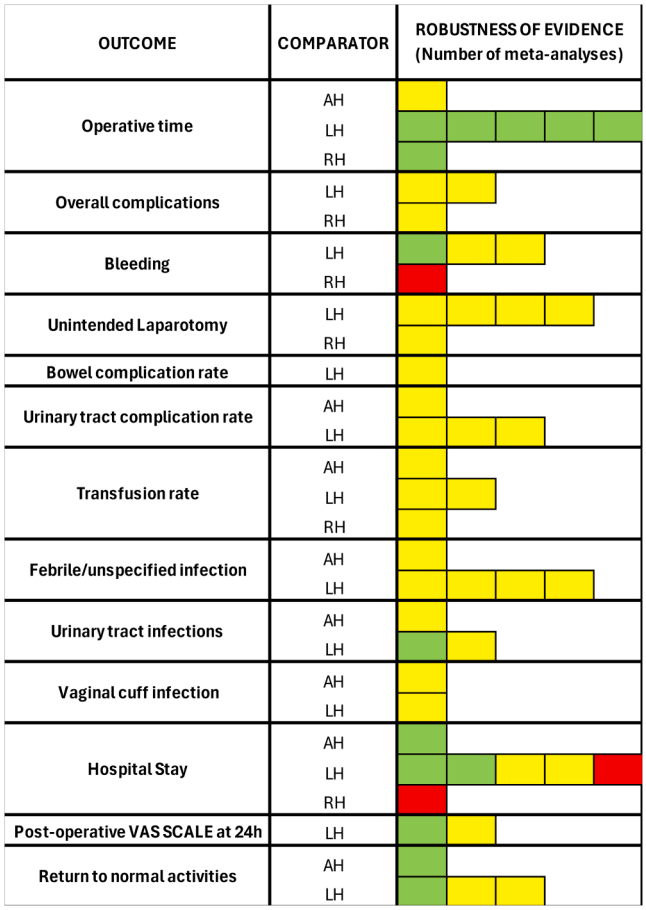

Fig. 2. Evidence map of meta-analyses on hysterectomy approaches
Visual representation of the strength and quantity of literature-based evidence. Each square corresponds to a meta-analysis. Green indicates findings favoring VH, yellow represents neutral findings, red favors the compared approach. *LH* laparoscopic hysterectomy, *VH* vaginal hysterectomy, *RH* robotic hysterectomy, *AH* abdominal hysterectomy.

5. Discussion

Traditionally, vaginal hysterectomy has been the hallmark procedure defining a gynaecologic surgeon [1].

Its renown benefits such as shorter operative time, better cosmetic results and most of all, its lower costs, seem not to be enough to counteract its decline in use, fewer VH are being performed, even though societies agree it remains recommended as the procedure of choice for benign hysterectomy [3,4].

The overall number of vaginal hysterectomies performed in the U.S. has declined by 19 % over 2 years and only 12 % of hysterectomies for benign indications are performed vaginally, while 66 % are performed laparoscopically or robotically [18].

This incessant drop has led to another alarming trend: vaginal hysterectomy is not widely taught anymore in residency programs and surgical fellowships, and less and less gynaecologists among the newer generations of physicians can be considered proficient in performing it [19,20]. Teaching trainees the key steps of VH is increasingly challenged by the rise of more captivating minimally invasive techniques that come with immersive simulation opportunities.

Furthermore, VH has largely been relegated to urogynecology for the treatment of prolapsed uteri, despite the potential to treat a broader range of benign gynecological conditions [1]. Nonetheless, according to correct indications, the authors are strongly in favor of the usage of the most technological and minimally invasive endoscopic surgical approaches for the treatment of challenging cases from benign conditions to oncologic disease.

Although we were not able to include a cost analysis in our overview, there is a broad literature based evidence on the topic. In the United States, $1.2 million Dollars could be saved for every 1000 hysterectomies performed vaginally, with a 20 % reduction of complications as shown by the study of Kovac in 2000 and by the study of Garry and Sculpher in 2004. In this context, LH represents a much more expensive approach as compared to VH considering the use of disposable instruments and the operating room time cost for a total amount of $780 per single procedure [21–23].

In 2015, a randomized controlled trial was conducted by a Swedish group to evaluate the hospital cost related to robotic hysterectomy (RH) compared to LH and VH performed to treat benign diseases. The total hospital cost for each procedure was significantly lower for VH ($4579) compared to LH ($7059) and robotic hysterectomy ($7016). The LH and RH costs were superimposable only in consideration of a pre-existing investment in the robotic platform [24]. The safety profile of this technique translates into a concrete reduction of costs for hospitals, an element that has become increasingly important over the years in healthcare economics, especially for developing countries.

5.1. Future perspectives

The current problems that have led to the concrete and constant reduction in the use of this technique are manifold. Generational change has played a decisive role, with the result that fewer and fewer young surgeons can perform VH, as the opportunities to witness these operations and subsequently learn them have been drastically reduced [19,20]. The decline of VH rates could be reversed structurally by the implementation of different countermeasures: minimally invasive endoscopic techniques using the transvaginal route, establishing and enforcing a minimum number of vaginal procedures to be performed by each trainee in residency programs and fellowships, adequately inform patients about the benefits and advantages of this type of approach and allow them to request it [19,20,25–27].

5.2. New technologies

Over the last few years, the VH approach has been enhanced by different technological innovations. First described in 2004, natural orifice transluminal endoscopic surgery (NOTES) represented the first innovative endoscopic technique allowing surgeons to access the peritoneal cavity without any abdominal wall incision [28]. The first hysterectomy completed thanks to the vaginal NOTES (vNOTES), which uses a vaginal colpotomy to access the peritoneal cavity, was reported in 2012 [29,30].

Data on benefits of vNOTES compared to LH in terms of length of hospital stay, postoperative pain, and recovery was provided by a systematic review and meta-analysis published by Baekelandt et al. [31]. The same Belgian group later published the HALON trial which was the first randomized controlled trial comparing vNOTES hysterectomy to LH in women with a non-prolapsed uterus for benign gynecologic diseases which suggested that the vNOTES hysterectomy was non-inferior to LH in terms of operating time and complications [32]. To date, randomized clinical trials are underway to compare vNOTES hysterectomy with VH for same-day patient discharge and to evaluate complications, postoperative recovery, quality of life, and cost-effectiveness.

Robot-assisted transvaginal NOTES (RvNOTES) is an innovative technology, that is spurring new enthusiasm to the minimally invasive surgery scene. These platforms are overwhelming the limitations of the conventional transvaginal approach by integrating all the benefits of standard laparoscopy and robotic technology into one instrument. In 2021, the very first article was published in the literature regarding RvNOTES hysterectomy using the new device called 'Hominis surgical system' (Momentis Surgical™ Ltd, Or Yehuda, Israel) which was used to treat 15 patients in a benign setting with evidence of safety and effectiveness [25].. In 2022, 84 patients underwent surgery with the 'Hominis' system, performed by an expert surgeon in LH and RH with evidence of proficiency achieved after 20 cases [26].

In the literature, the da Vinci Xi™ (Intuitive Surgical, Sunnyvale, California, United States) was the other robotic platform which was involved in the RvNOTES hysterectomy experience for benign gynecologic conditions thanks to the Koythong comparative retrospective analysis with the conventional vNOTES technique [27]. After the evaluation of 114 patients' perioperative outcomes, the authors stated that RvNOTES hysterectomy was a feasible and safe technique, with outcomes that were superimposable to vNOTES hysterectomy.

5.3. Educational impact

Trainees have inevitably undergone the changes imposed upon them by the increasing implementation of endoscopic surgery such as laparoscopy and robotics, which can be much more fascinating and easier to learn [19,20]. Concurrently, there has been a marked reduction in the teaching of this technique by senior surgeons. Residents must have the opportunity to be adequately trained so to independently apply it in their future clinical practice. The risk of neglecting preservation of this heritage could well lead to a slow and progressive absence of surgeons capable of performing VH. As a result, organizing training sessions exclusively dedicated to the deployment of this surgical technique could well fill the emerging knowledge gap. Further randomized studies comparing the new technological platforms to conventional VH are necessary to evaluate their safety and efficacy.

6. Conclusions

Our results indicates that VH is associated with a shorter time from hospital admission to recovery compared to AH, and a shorter operative time compared to AH, LH and RH. No clear difference was found regarding intra- and postoperative complications. One can well understand how VH should be recognized as a valid approach that should be offered when indicated. This study was designed and conducted in response to the necessity of understanding the reasons for the progressive declining role of vaginal surgery despite its advantages and to explore which innovations have emerged that could spur new enthusiasm for this approach in recent years. It would be beneficial to draw a line to look back at the past as it is the only way to understand the future perspectives of a technique at the core of gynecologic surgery.

Declarations of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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