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REVIEW ARTICLE

Interventions to reduce morbidity from vault hematoma following vaginal hysterectomy: a systematic review and meta-analysis

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Abstract

Introduction and hypothesis A frequent complication following vaginal hysterectomy is the formation of vaginal vault hematoma. The objective of our systematic review was to assess the impact of various interventions in reducing the incidence of vault hematoma or postoperative febrile morbidity following vaginal hysterectomy.

Methods We carried out a systematic search of Cochrane, MEDLINE, Embase, CINAHL, HTA database, PROSPERO, meta-Register of Controlled Trials (mRCT), PubMed, CENTRAL, Google Scholar, conference abstracts, and a hand search of journals from inception until September 2018. Our search strategy included interventions in women undergoing vaginal hysterectomy with modified vault closure with inclusion of peritoneal edges, vaginal vault drainage, or vaginal packing to reduce the incidence of clinically significant vault hematomas. Two independent reviewers (SR and AD) extracted data using a structured proforma. Meta-analysis was carried out using RevMan 5.3 software.

Results We identified two studies on modified vaginal vault closure incorporating peritoneal edges that reported a significant reduction in vault hematoma incidence. Meta-analysis of two randomized trials on vaginal drains showed no difference in postoperative febrile morbidity secondary to vault hematoma [risk ratio (RR) 0.8, 95% confidence intervals (CI) 0.43–1.50]. Similar results were seen on meta-analysis of four randomized trials on the use of vaginal packing (RR 0.8, 95% CI 0.43–1.50).

Conclusions Inclusion of peritoneal edges in vaginal vault closure may reduce the incidence of vault hematoma. The routine use of vaginal vault drainage and/or packing has not shown to reduce vault hematoma incidence or postoperative febrile morbidity. We recommend a change of practice to include peritoneal edges in vault closure based on the evidence available in our systematic review.

Keywords Vaginal hysterectomy · Packing · Drain · Systematic review · Vaginal cuff closure · Vault hematoma

Introduction

Vaginal hysterectomy is a recommended surgical procedure for benign gynecological conditions and pelvic organ prolapse (POP) [1]. Vaginal hysterectomy facilitates reduced postoperative discomfort, shorter postoperative stay, and faster postoperative recovery [2]. A common postoperative complication is formation of a vaginal vault hematoma and the consequent febrile morbidity [3]. The reported incidence of vault hematoma after vaginal hysterectomy ranges from 25 to 59% [4]. Most are asymptomatic, with only 6–9% needing treatment [5, 6].

Hematoma serves as a culture medium for the proliferation of bacteria and results in pyrexia, anemia, pelvic discomfort, secondary hemorrhage, blood transfusion, and return to theater for evacuation. Treatment options of vaginal vault hematoma range from a course of antibiotics to surgical drainage depending on the clinical picture. Some interventions to reduce the risk of vault hematoma and postoperative pyrexia include antibiotic prophylaxis and electrocautery of pedicles, with the latter shown to be beneficial and becoming the accepted standard intervention [7]. Electrocautery for pedicle sealing during vaginal hysterectomy has shown no difference in vaginal vault hematoma formation in a systematic review and meta-analysis [8].

During vaginal hysterectomy, traditional vaginal vault closure might involve closing the visceral peritoneum around the

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vaginal vault separately from that of the vault, leaving a potential space between the two or not completely closing the visceral peritoneum. Any oozing from the free peritoneal edges might result in a collection of blood within this potential space and formation of vaginal vault hematoma [9]. Modifications in the technique of vault closure need to be evaluated further. A frequent practice is to fill the vaginal cavity with a gauze pack and remove it the morning of the first postoperative day. The systematic review and guideline produced by the Society of Gynecological Surgeons (SGS) on the risks and benefits of technical steps and interventions at the time of vaginal hysterectomy recommends against routine vaginal packing after a vaginal hysterectomy, indicating that the risks of postoperative vaginal packing generally outweigh the benefits for most patients [10]. However, individual studies on vaginal packing included in the SGS systematic review report no increase in postoperative pain or bleeding in women who had vaginal packs compared with those who did not. In a study of vaginal vault drainage during complicated laparoscopic-assisted vaginal hysterectomy with wide dissection, large volume of operative blood loss, intraoperative oozing, blood coagulation defects, and coexisting pelvic lesions, there were no adverse effects particularly related to drain insertion [11]. The role of vaginal vault drainage in reducing vault hematoma during vaginal hysterectomy is uncertain.

So far there is insufficient evidence on the most appropriate intervention or a combination of interventions needed to reduce the incidence of vault hematoma. The aim of our systematic review was to evaluate the role of various interventions—like modified vaginal vault closure, vaginal packing, and vault drainage—in reducing the risk of vault hematoma (primary outcome) and febrile morbidity (secondary outcome).

Materials and methods

We prospectively registered our study protocol for systematic review in PROSPERO database with the registration number: CRD42017083955. We carried out a systematic search of Cochrane, MEDLINE, Embase, CINAHL, HTA database, PROSPERO, meta-Register of Controlled Trials (mRCT), PubMed, CENTRAL, and Google Scholar databases from inception until September 2018. Abstracts presented at the International Urogynecology Association (IUGA), International Continence Society (ICS), and United Kingdom Continence Society (UKCS) up to September 2018 and a hand search of journals was carried out using the keywords vault hematoma, vaginal hysterectomy, drains, electrocautery, surgical technique, vaginal packs, and postoperative morbidity. We included only articles published in English and unsuccessfully attempted to contact authors of conference abstracts for further information. Ethical approval was not required, as this was a systematic review. Articles captured during the search were analyzed, and studies meeting our criteria were selected. Two reviewers (SR and AD) selected the studies independently. Data presented as conference abstracts were also included. We assessed methodological quality using the following criteria:

1. Quality assurance was assessed using the Newcastle–Ottawa scale [12, 13] for cohort studies to assess study selection, comparability of cohorts, and outcomes assessed. Good-quality studies may score 8–13 stars.
2. Cochrane's risk of bias tool [14] was used to assess methodological quality for RCTs, as it includes sequence generation, allocation of sequence concealment, blinding, incomplete outcome data, selective outcome reporting, and other potential sources of bias.

Study inclusion

Our literature search identified review articles, cohort studies, and studies in which the incidence of vault hematomas were compared with and without various interventions. We included studies using vaginal drains, vaginal packing, and modified vault closure technique incorporating the peritoneum to reduce the risk of vault hematomas during vaginal hysterectomy. The four-part clinical question for this systematic review was as follows:

- P (Population): adult women undergoing vaginal hysterectomy
- I (Intervention): use of modified surgical techniques or vaginal drains or vaginal packs
- C (Comparison): conventional vaginal hysterectomy without the use of any of the above-mentioned modifications
- O (Outcome): reduction in the incidence of vault hematoma (primary outcome)/postoperative pyrexia (secondary outcome)/return to theater

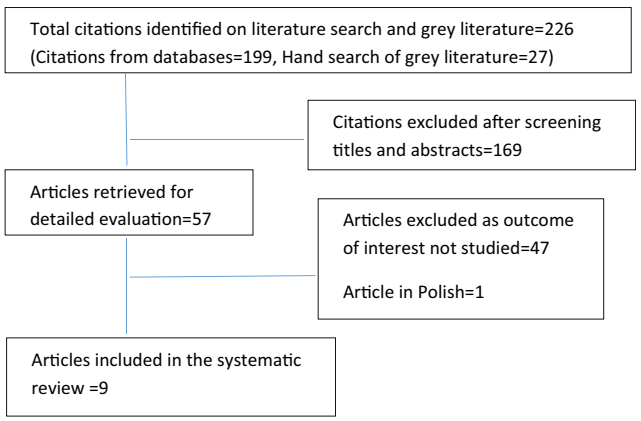

Fig. 1 Study selection for inclusion in systematic review

Table 1 Characteristics of modified vault closure studies

Study	Setting	Inclusion criteria	Methods	Intervention (I) and Comparison (C)	Outcome measures and follow-up
Morris EP [9], 2001, UK, retrospective case note analysis	Single center ($n = 581$)	Women undergoing vaginal hysterectomy over a 5-year period	Retrospective study followed by prospective analysis of postoperative morbidity	Inclusion of peritoneum in vault closure up to and including the uterosacral ligaments (I) compared with closure or nonclosure of peritoneum separate to the vaginal skin during vault closure (C)	Reduced incidence of vault hematoma from 15.7% in control (C) group to 1.7% in intervention group (I)
Miskry T, [8] 2001, UK	Single center ($n = 70$)	Women undergoing vaginal hysterectomy	70 consecutive women undergoing vaginal hysterectomy without repair; 24 (34%) underwent simultaneous bilateral salpingo-oophorectomy	Modified technique included mass closure of vaginal edges along with the peritoneum, including the uterosacral ligaments (I) compared with traditional closure with purse stringing of the peritoneum at the vaginal vault and closing the vaginal edges separately (C)	Vault hematomas in 5.7% in the modified technique group. The authors had no control group and compared outcomes with those of previously published data

Statistical analysis

Statistical meta-analysis was performed using the RevMan 5.3 software provided by the Cochrane Collaboration (http://ims.cochrane.org/revman). Confidence intervals (CI) were set at 95%. Heterogeneity between RCTs was assessed using the chi-square and I^2-statistic tests. P value <0.05 was defined to note statistical significance in the analysis of heterogeneity. Risk ratios (RR) and 95% C) for all outcomes were calculated using DerSimonian-Laird random-effects model. Specifically, for all analyses, results from fixed-effects model are presented when I^2 statistic used to assess heterogeneity between studies was low. Publication bias was not assessed due to the small number of studies.

Results

Our literature search identified 226 study titles, from which we selected 57 for more detailed review. Of them, nine were included in our final review. Literature flow of eligible studies is depicted in Fig. 1. Of the nine articles identified, two were on modified closure of the vaginal vault incorporating the peritoneum, four were on vaginal packing, and three were on vaginal drains.

Data abstraction, quality assessment, and synthesis of results

Study results were entered into data tables for each intervention: Table 1 for modified vault closure, Table 2 for vaginal drains, and Table 3 for vaginal packing summarize baseline characteristics, interventions, comparisons, outcomes assessed, and duration of follow-up. Study quality assessment is shown in Figs. 2 and 3

Risk of bias assessment

On Cochrane risk of bias assessment of randomized studies, four of six studies were of good quality (Fig. 2). The nonrandomized studies (two on modified vault closure and one on Foley catheter drain) in the systematic review were assessed using the Newcastle–Ottawa scale (Fig. 3); two of three studies scored 7 stars (good quality).

Outcomes for modified surgical closure of vaginal vault

We identified two studies that included the peritoneum in vaginal vault closure compared with the previous practice mentioned in text books where peritoneum above the vault is closed separately or not closed, and vaginal vault closure is a separate step. Inclusion of the peritoneum in vault closure

Table 2 Characteristics of vaginal drain studies

Study	Setting/patient characteristics	Inclusion criteria	Exclusion criteria	Intervention, methods, follow-up duration	Outcome measures	Return to theater/hematoma
Krishnaswamy [15], 2018, UK	Single center Retrospective case control	Premenopausal women undergoing vaginal hysterectomy	Malignancies, postmenopausal women	52 consecutive women had pelvic Foley catheter drain inserted at the time of vaginal hysterectomy compared with 51 women without drain insertion	Primary outcome: vaginal vault hematoma; secondary outcome: length of hospital stay, postoperative pyrexia, antibiotic use (postoperative)	Hematoma
Dua [11], 2011, UK	Single center	Women undergoing vaginal hysterectomy with or without vaginal prolapse repair for benign gynecological disease	Hysterectomies performed for malignancies or when the surgeon felt that surgical drain insertion to the vaginal vault was clinically indicated	Women were randomized to drain ($n = 135$) or no drain arm ($n = 137$) Patient's allocation to each group was concealed until closure of the vaginal vault; follow-up 6 weeks	Primary outcome: postoperative febrile morbidity; secondary outcome immediate complications of hemorrhage, return to theater, blood transfusion, change in postoperative hemoglobin, and length of hospital stay	Clinically significant febrile morbidity of >38 °C seen in 17/135 women in the drain group and (15/137) in the no drain group; febrile morbidity considered to roughly equate to vault hematoma Pelvic US for hematoma was done, vaginal vault infection rates from introduction of vaginal drain as a foreign body was not considered a confounding factor
Swartz, [16] 1976, USA	Single center, RCT in women undergoing vaginal hysterectomy ± pelvic floor repairs ($n = 87$)	Women undergoing vaginal hysterectomy	None mentioned	Women were randomized to T-tube suction drainage and prophylactic antibiotics ($n = 45$) or no drain arm ($n = 42$) with only prophylactic antibiotics	Primary outcome: reduction in febrile postoperative morbidity; secondary outcome pelvic abscess, hematoma, purulent cuff drainage	Clinically significant hemorrhage/vault hematoma were zero in the drain group (0/45) compared with (2/42) in the no drain group. Seven patients in each group had febrile morbidity in the absence of pelvic infection

RCT randomized controlled trial, *US* ultrasound

Table 3 Characteristics vaginal packing studies

Studies	Setting/patient characteristics	Inclusion criteria	Exclusion criteria	Intervention, methods, and duration of follow-up	Outcome measures	Return to theater/hematoma
Westermann [17] 2016, USA	Prospective, single-blinded RCT involving women undergoing vaginal hysterectomy ($n = 77$)	Women 18–85 years, vaginal hysterectomy for benign disease, English speaking, willing to provide informed consent	Repairs not involving vaginal hysterectomy, use of mesh, vaginal obliterative procedures, concurrent removal of mesh from anterior, posterior or apical compartments, vaginal-relaxing incisions, diagnosed clotting disorder, pelvic malignancy, current anticoagulation, preoperative thromboprophylaxis, intraoperative blood loss >500 ml, regional anesthesia	Women were randomized to packing ($n = 37$) or nonpacking arm ($n = 40$) Patient allocation to each group concealed until completion of surgery Follow-up = 6 weeks	Primary outcome pain scores Secondary outcome: immediate complications of hemorrhage, return to theater, postoperative vaginal vault hematoma/abscess	No clinically significant hematoma in pack group (0/37) compared with two (2/40) in the nonpacking group. Pelvic US showed 0.5–2.1 cm hematoma in 4/37 in pack group and 7/40 in nonpack group. No difference in VAS pain or satisfaction scores between groups.
Thiagamoorthy, [18] 2014, UK	Single center, double-blind RCT in women undergoing vaginal hysterectomy- ± pelvic floor repairs ($n = 190$)	Women >18 years, vaginal hysterectomy for benign disease, English speaking, willing to provide informed consent	Women with high risk of postoperative morbidity like clotting abnormalities, in immunocompromised states, and having previous pelvic floor surgery	Women were randomized to pack ($n = 86$) or non-packing arm ($n = 87$) Patient allocation to each group was concealed until completion of surgery. Primary outcome assessor was blinded Follow-up = 6 weeks. Primary outcome: pain Secondary outcome: hematoma	Immediate complications of hemorrhage, return to theater, and postoperative vaginal vault hematoma/abscess	Zero clinically significant hemorrhage/ vault hematoma in pack group (0/86) compared with three (3/87) in nonpack group (one return to theater for vaginal angle bleeding and two infected hematomas). On pelvic US 6 weeks postoperatively, 7.3% of pack and 14.3% of nonpack group had hematomas >2 cm
Urzua, [19] 2013, Chile	Prospective RCT in two hospitals of women undergoing vaginal hysterectomy ($n = 144$)	Women undergoing vaginal hysterectomy, willing to provide informed consent	Not mentioned	Pack group ($n = 74$) and nonpack group ($n = 70$) Primary outcome: Vault hematoma Follow-up: 7 days	Immediate complications of hemorrhage, return to theater, and vaginal vault hematoma	Clinically significant hematoma rates: 0/74 compared with 3/70 US on day 7: hematoma >1 ml was 2.7% in pack group and 12.9% in the nonpack arm
Baumgarten, [20] 2010, Netherlands	Prospective RCT of women undergoing vaginal hysterectomy ($n = 43$)	Women undergoing any vaginal surgery for prolapse	Women undergoing TVT/TOT or combined abdominal or vaginal surgery	Randomized to pack ($n = 22$) and nonack group ($n = 21$) Primary outcome: hemorrhage/hematoma Secondary outcome: UTI	Postoperative bleeding or infection	Hematoma in 2/22 in pack group and 0/21 in nonpack group UTI: 1/22 in pack group and 2/22 in nonpack group

RCT randomized controlled trial, *TVT/TOT* transvaginal/transobturator tape, *UTI* urinary tract infection, *VAS* visual analog scale, *US* ultrasound, *UTI* urinary tract infection

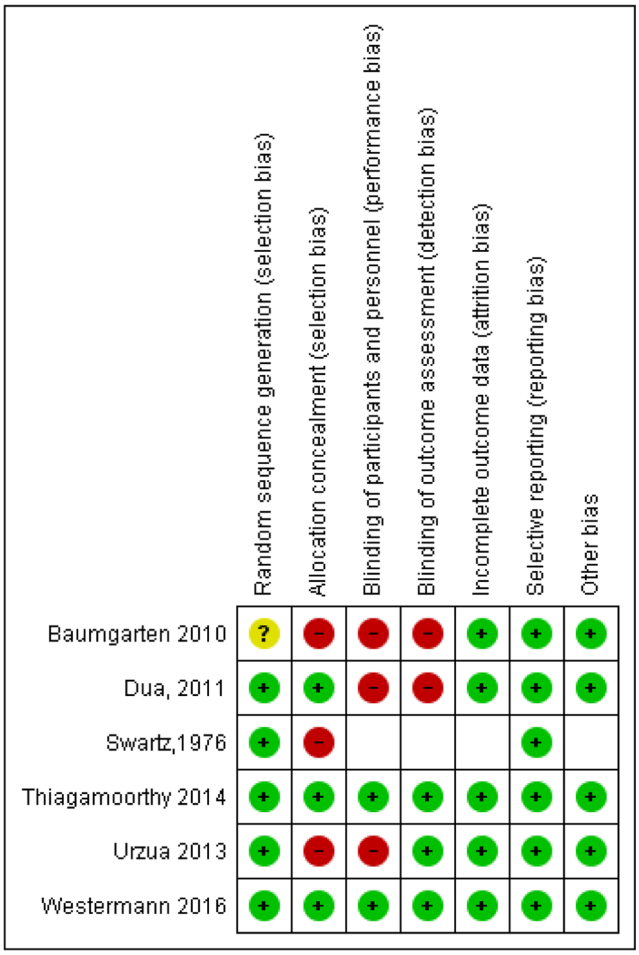

Fig. 2 Risk of bias assessment of randomized trials

reduces the dead space between the peritoneal layer and the vaginal vault. The first study of 581 women undergoing vaginal hysterectomy carried out over a 5-year period showed a reduction in clinically significant vault hematoma from 15.7% (conventional vault closure technique) to 1.7% (modified vault closure incorporating peritoneum into the vault) [15]. In another study of 70 women with mass closure of the peritoneum and vaginal vault incorporating uterosacral ligaments, the symptomatic vault hematoma rate was reported to be 5.7%, and these women were managed conservatively. One woman needed a blood transfusion on the seventh postoperative day when she presented with bleeding [16]. We did not perform a meta-analysis, as the study design, data presentation, and reporting of outcome variables was very different between studies.

Outcomes for vaginal drains

We included three studies on pelvic drain usage inserted at the time of vaginal vault closure (two randomized trials and one retrospective case control study). A significant reduction of vault hematoma (8 vs 0; $p = 0.0025$), length of hospital stay (15 vs 3; $p = 0.001$), antibiotics usage for vault hematoma (0 vs 5; $p = 0.028$), and readmission rates (7 vs 0; $p = 0.005$) in women who had a drain inserted at the time of their hysterectomy was seen in a retrospective study of 52 premenopausal women who had Foley catheter drain compared with 51 premenopausal women without a drain [20].

In a study of 306 women undergoing vaginal hysterectomy randomized to vaginal drain compared with no vaginal drain, 15/135 women in the drain group and 17/137 in the no-drain group had postoperative febrile morbidity (pyrexia ≥38 °C).

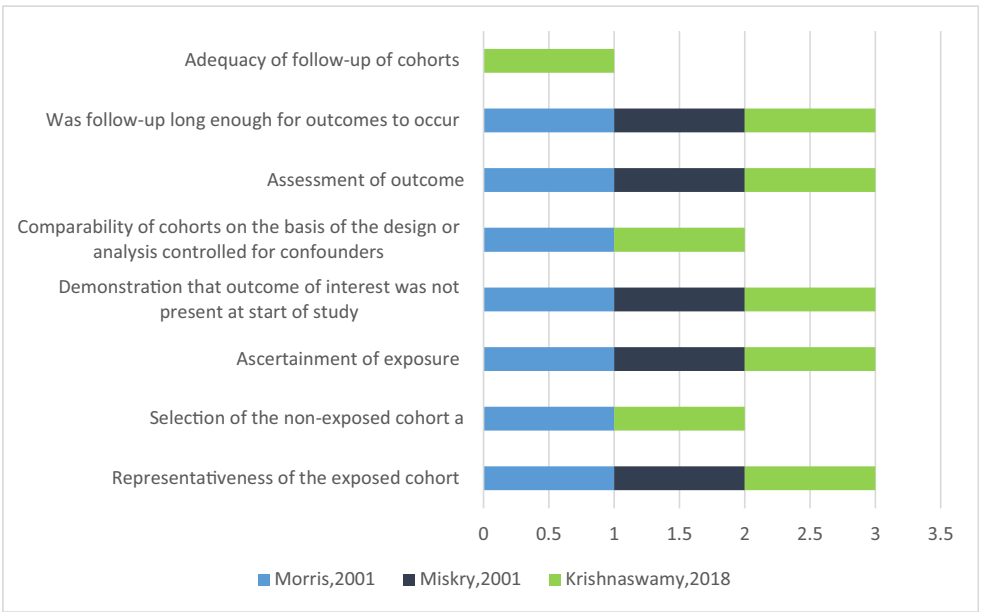

Fig. 3 Newcastle–Ottawa scale for assessment of cohort studies

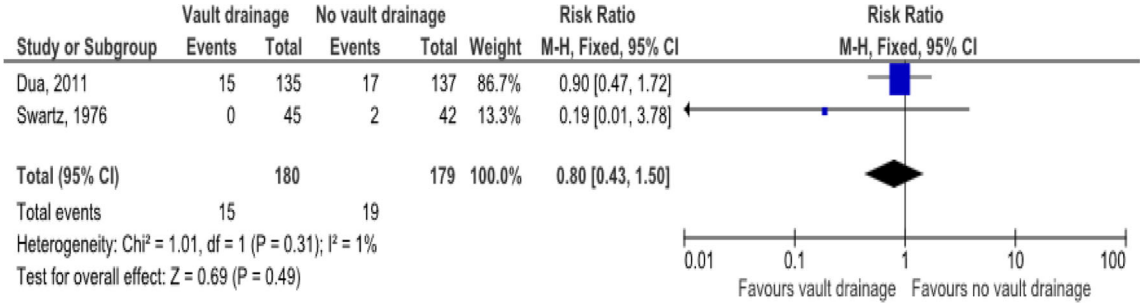

Fig. 4 Vault drainage in reducing postoperative febrile morbidity

RR was 0.90, which was not statistically significant [19]. In another randomized study of 87 women, none in the drain group and 2/42 in the no-drain group had postoperative febrile morbidity [18]. On meta-analysis, the RR was 0.8 with 95% CI of 0.43–1.50 (Fig. 4), with no significant difference in the incidence of febrile morbidity in both the groups, though there was a trend toward reduced incidence of febrile morbidity in the drain group. Therefore, it would appear that drains do not significantly reduce the incidence of vault hematoma.

Outcomes for vaginal packing

Four randomized trials on the use of vaginal pack versus no pack were included in the meta-analysis [17, 21–23]. A total of 437 women were randomized into two groups: pack and no pack. The incidence of clinically significant vault hematoma was 2/219 (pack group) compared with 8/218 (no pack group). The collated data analysis showed a RR of 0.37 with 95% CI of 0.07–1.99 (Fig. 5), indicating the absence of any statistically significant difference in both the groups. Heterogeneity reported on I^2 was 1% for the vaginal vault drainage group and 21% for the vaginal pack group. Low heterogeneity ($I^2 < 25\%$) enabled us to use a fixed-effects model for our meta-analysis (Figs. 4 and 5) [24]. The quality and level of evidence were analyzed in accordance with the Grading of Recommendations Assessment, Development and Evaluation (GRADE) methodology using GRADEpro software tool (www.gradepro.org/) [25, 26] (Table 4).

Discussion

Postoperative morbidity following vaginal hysterectomy ranged from vaginal vault hematoma to postoperative hemorrhage needing a return to theater and febrile morbidity. Inclusion of the peritoneum in vault closure reduced these complications of vaginal vault hematomas/febrile morbidity to a significant extent, without added morbidity. The interventions of using vaginal vault drainage and vaginal packs immediately following vaginal hysterectomy were not shown to make a difference in reducing postoperative morbidity. There were no reports of increase in pain scores or any other adverse effects associated with the pack or during drain removal in any study in our systematic review.

Our literature search was extensive, involving all available databases and gray literature. Our systematic review is first of its kind to compare outcomes of surgical modifications during and after vaginal vault closure in reducing vaginal vault hematoma and postoperative pyrexia in patients undergoing vaginal hysterectomy. A recent systematic review was carried out by the SGS studied 18 different interventions before, during, and after vaginal hysterectomy to construct the best evidence-based practice. Similarly, a Cochrane systematic review on perioperative interventions in pelvic organ prolapse surgery examined various interventions during vaginal hysterectomy in reducing short- and long-term morbidity. Our systematic review focused on two interventions (drain and modified vault closure) not included in the SGS and Cochrane reviews, placing specific focus on reduction of vaginal vault

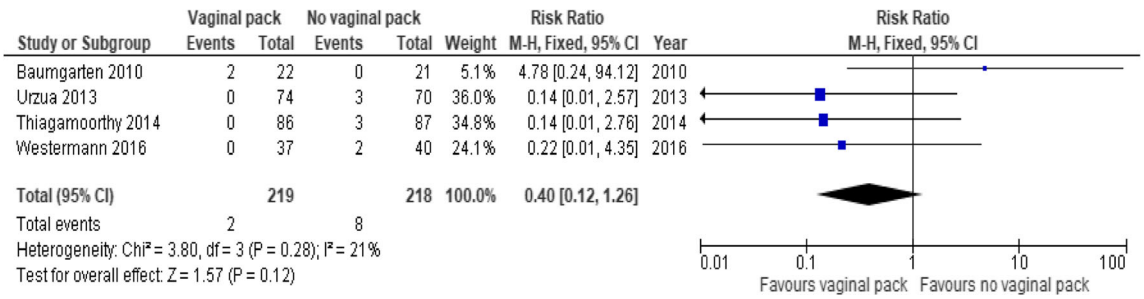

Fig. 5 Role of vaginal packing in reducing vaginal vault hematoma following vaginal hysterectomy

Table 4 GRADE assessment of included studies

Outcomes	Participant (studies) follow-up	Certainty of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with no interventions	Risk difference with interventions to reduce vaginal vault hematoma
Modified vaginal vault closure in reducing the incidence of vaginal vault hematoma	651 (2 observational)	⊕○○○ very low[a]	Not pooled	Not pooled	Not pooled
Vaginal vault drainage in reducing postoperative febrile morbidity	359 (2 RCTs)	⊕○○○ very low[a,b]	RR 0.80 (0.43 to 1.50)	11 per 100	2 fewer per 100 (6 fewer to 5 more)
Vaginal vault drainage in reducing postoperative febrile morbidity	103 (1 observational)	⊕○○○ very low[a,b]	Not pooled	Not pooled	Not pooled
Vaginal packs after vaginal hysterectomy in reducing vault hematoma	437 (4 RCTs)	⊕⊕⊕○ moderate	RR 0.37 (0.07 to 1.99)	4 per 100	2 fewer per 100 (3 fewer to 4 more)

GRADE Working Group grades of evidence: High certainty: very confident that the true effect lies close to that of the estimate of the effect; moderate certainty: moderately confident in the effect estimate, and the true effect is likely to be close to the estimate of the effect but with a possibility it is substantially different; low certainty, where confidence in the effect estimate is limited and the true effect may be substantially different from the estimate of the effect; very low certainty: very little confidence in the effect estimate, and true effect is likely to be substantially different from the estimate of effect

RCT randomized controlled trials, *CI* confidence interval, *RR* risk ratio, *GRADE* Grading of Recommendations Assessment, Development and Evaluation

Explanations

[a] We did not perform meta-analysis for this outcome due to significant study design differences

[b] A retrospective case–control study on vaginal vault drainage and hence not included in the meta-analysis due to study design inconsistency

hematoma or postoperative pyrexia [10]. These interventions are very simple techniques without any added morbidity or requirement of surgeon training.

For the interventions on vaginal vault drainage and vaginal packing, we included randomized trials with very similar study design, patient population, and reporting of outcomes. On meta-analysis, heterogeneity reported on I^2 was 1% for the vaginal vault drainage group and 21% in the vaginal packing group. Low heterogeneity improves generalizability and clinical applicability of our findings, as populations in studies on adult women are similar to those seen in routine clinical practice. Attrition and reporting bias were almost nonexistent in all studies, as they required no long-term follow-up. We adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist for reporting the meta-analyses.

We acknowledge several limitations of this review. The conclusion was limited by the lack of randomized trials on the role of modified vaginal vault closure to include the peritoneal edge. The two cohort studies [15, 16] for this intervention were methodologically limited by the retrospective nature of the study design and methods used to diagnose vault hematoma and size cutoff to diagnose a sonological vault hematoma. There was significant heterogeneity in reporting outcome measures, such as clinical diagnosis of vaginal vault hematoma to ultrasound diagnosis (size cutoff to diagnose hematoma has varied from 2 to 5 cm).

Publication bias could not be assessed, as we found only nine studies for our systematic review. GRADE quality and level of evidence was low for two of the three interventions: modified vault closure and use of vaginal drains due to the inconsistency from diversities in study designs, defining outcome measures and imprecision induced by the relatively small number of participants in the studies, and wide CIs without overlap. Power calculation using a Superiority RCT design would have improved reporting validity of RCTs in our meta-analysis on vaginal vault drainage and vaginal packing.

Conclusion and recommendations

Adequately powered superiority RCT on modified closure of the vaginal vault to include the peritoneal edge may help form a strong conclusion regarding this issue. A total of 1810 women need to be recruited to demonstrate a 50% reduction in clinical hematoma formation with 80% power. Such a large RCT will need a significant amount of time and resources. The technique of visceral peritoneal inclusion in vaginal vault closure is very simple, less time consuming (compared with separate closure or nonclosure of the peritoneum), and without major risk of ureteric injury. We therefore recommend a change of practice to include peritoneal edges in vault closure based on the evidence available in our systematic review.

We do not recommend routine use of vaginal vault drains and vaginal packs to reduce postoperative vaginal vault hematoma due to the lack of strong evidence in their favor. Vault drainage and use of packs are once again very simple interventions with no significant impact on morbidity and healthcare costs. Temporary use of foreign bodies like drains or vaginal packs have not shown an increase in febrile morbidity. Clinicians, reluctant to use vaginal vault drains, may be reassured with these findings and need not hesitate to use them. These two interventions may be used in complex cases where achieving hemostasis is challenging.

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Compliance with ethical standards

Conflicts of interest None.

Details of ethical approval Ethical approval was not required as this is a systematic review of published manuscripts.

References

1. Gupta J. Vaginal hysterectomy is the best minimal access method for hysterectomy. Evid Based Med. 2015;20(6):210.
2. Gitsch G, Berger E, Tatra G. Trends in thirty years of vaginal hysterectomy. Surg Gynecol Obstet. 1991;172(3):207–10.
3. Thomson AJ, Farquharson RG. Vault haematoma and febrile morbidity after vaginal hysterectomy. Hosp Med. 2000;61(8):535–8.
4. Kuhn RJ, de Crespigny LC. Vault haematoma after vaginal hysterectomy: an invariable sequel? Aust N Z J Obstet Gynaecol. 1985;25(1):59–62.
5. Dane C, Dane B, Cetin A, Yayla M. Sonographically diagnosed vault hematomas following vaginal hysterectomy and its correlation with postoperative morbidity. Infect Dis Obstet Gynecol. 2009;2009:91708.
6. Thomson AJ, Sproston AR, Farquharson RG. Ultrasound detection of vault haematoma following vaginal hysterectomy. Br J Obstet Gynaecol. 1998;105(2):211–5.
7. Ayeleke RO, Mourad S, Marjoribanks J, Calis KA, Jordan V. Antibiotic prophylaxis for elective hysterectomy. Cochrane Database Syst Rev. 2017;6:CD004637.
8. Pergialiotis V, Vlachos D, Rodolakis A, Haidopoulos D, Christakis D, Vlachos G. Electrosurgical bipolar vessel sealing for vaginal hysterectomies. Arch Gynecol Obstet. 2014;290(2):215–22.
9. Gupta JK, Sengupta-Giridharan R, Clark TJ. A randomized, controlled trial of open versus closed vaginal vault at vaginal hysterectomy. Acta Obstet Gynecol Scand. 2005;84(1):90–1.
10. Jeppson PC, Balgobin S, Rahn DD, Matteson KA, Dieter AA, Ellington DR, et al. Comparison of vaginal hysterectomy techniques and interventions for benign indications: a systematic review. Obstet Gynecol. 2017;129(5):877–86.

11. Lee SJ, Roh HJ, Cho HJ, Lee SH, Ahn JW, Kwon YS. Vaginal vault drainage after complicated single-port access laparoscopic-assisted vaginal hysterectomy. Gynecol Minim Invasive Ther. 2017;6(2):58–62.
12. Stang A. Critical evaluation of the Newcastle-Ottawa scale for the assessment of the quality of nonrandomized studies in meta-analyses. Eur J Epidemiol. 2010;25(9):603–5.
13. Wells G, O'connell D, Peterson J, Welch V, Losos M, et al. The Newcastle-Ottawa scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses. Ottawa: Ottawa Hospital Research Institute; 2011.
14. Page MJ, McKenzie JE, Kirkham J, Dwan K, Kramer S, Green S, et al. Bias due to selective inclusion and reporting of outcomes and analyses in systematic reviews of randomised trials of healthcare interventions. Cochrane Database Syst Rev. 2014;10:MR000035.
15. Morris EP, El-Toukhy T, Toozs-Hobson P, Hefni MA. Refining surgical technique to prevent occurrence of vault haematoma after vaginal hysterectomy. J Obstet Gynaecol. 2001;21(4):379–82.
16. Miskry T, Magos A. Mass closure: a new technique for closure of the vaginal vault at vaginal hysterectomy. BJOG. 2001;108(12):1295–7.
17. Baumgarten M, Vos C, Vervest H. Short term postoperative complications after vaginal packing, a randomised controlled study. In: ICS, Toronto, Canada. 2010.
18. Swartz WH, Tanaree P. T-tube suction drainage and/or prophylactic antibiotics. A randomized study of 451 hysterectomies. Obstet Gynecol. 1976;47(6):665–70.
19. Dua A, Galimberti A, Subramaniam M, Popli G, Radley S. The effects of vault drainage on postoperative morbidity after vaginal hysterectomy for benign gynaecological disease: a randomised controlled trial. BJOG. 2012;119(3):348–53.
20. Krishnaswamy PH, Jha MS. Efficiency of using a Foley catheter as a pelvic drain in vaginal hysterectomy. Eur J Obstet Gynecol Reprod Biol. 2018;226:21–4.
21. Urzua M, Astorquiza MRC, Braun H. Post vaginal hysterectomy packing, is it worth? Prospective randomised study. In: IUGA Annual Meeting, Dublin, Ireland. 2013.
22. Thiagamoorthy G, Khalil A, Cardozo L, Srikrishna S, Leslie G, Robinson D. Te value of vaginal packing in pelvic floor surgery: a randomised double-blind study. Int Urogynecol J. 2014;25(5):585–91.
23. Westermann LB, Crisp CC, Oakley SH, Mazloomdoost D, Kleeman SD, Benbouajili JM, et al. To pack or not to pack? A randomized trial of vaginal packing after vaginal reconstructive surgery. Female Pelvic Med Reconstr Surg. 2016;22(2):111–7.
24. Higgins JP, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. BMJ. 2003;327(7414):557–60.
25. Zhang Y, Alonso-Coello P, Guyatt GH, Yepes-Nuñez JJ, Akl EA, Hazlewood G, et al. GRADE guidelines: 19. Assessing the certainty of evidence in the importance of outcomes or values and preferences-risk of bias and indirectness. J Clin Epidemiol. 2018. https://doi.org/10.1016/j.jclinepi.2018.01.013.
26. Zhang Y, Coello PA, Guyatt GH, Yepes-Nuñez JJ, Akl EA, Hazlewood G, et al. GRADE guidelines: 20. Assessing the certainty of evidence in the importance of outcomes or values and preferences-inconsistency, imprecision, and other domains. J Clin Epidemiol. 2018. https://doi.org/10.1016/j.jclinepi.2018.05.011.