Early versus delayed urinary catheter removal after hysterectomy: A systematic review and meta-analysis

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Short title: Removal of urinary catheter after hysterectomy

Abstract

Objectives: In bladder drainage, an essential part of post-hysterectomy care, the optimal timing for removing the urinary catheter is unclear. Our objective was to evaluate the risks and benefits of early (<6 hours) vs delayed (>6 hours) catheter removal post-hysterectomy.

Study design: A systematic review searching MEDLINE, EMBASE and Cochrane CENTRAL from inception till May 2019 for randomised trials of women undergoing hysterectomy. We reported on urinary retention, positive urine culture, urinary tract infection (UTI) (defined by symptoms and/or antibiotic use), post-operative pyrexia, time to ambulation, and length of hospital stay. We assessed risk of bias in included trials and used a random-effect model to generate risk ratios (RR) for dichotomous outcomes and weighted mean differences (WMD) for continuous outcomes, with 95% confidence intervals (CI).

Results: Of 1020 potentially relevant citations, we included 10 randomised trials (1120 women). Four trials had low risk of bias for randomisation and allocation concealment while five had low risk for outcome assessment and selective reporting. Compared to delayed removal, women in the early catheter removal group had a higher risk of urinary retention and needing re-catheterisation (10 RCTs, RR 3.61, 95%CI 1.21-9.21, I^2=56%). There was some reduction in the risk of post-operative UTI (6 RCTs, RR 0.42, 95%CI 0.18 to 0.96, I^2=0%), but we did not find a significant difference in post-operative pyrexia (6 RCTs, RR 0.73, 95%CI 0.43-1.24, I^2=18%) or positive urine cultures (6 RCTs, RR of 0.56, 95%CI 0.27-1.12, I^2=55%). There was no significant difference in the average time to ambulation (3RCTs, WMD -4.6, 95%CI -9.16 to -0.18, I^2=98%) and length of hospital stay (3RCTs, WMD -1.05, 95%CI -2.42 to 0.31, I^2=98%). Our meta-regression on the provision of prophylactic antibiotics did not show a significant effect on the reported outcomes. Our analysis was limited by our inability to adjust for potential effect modifiers such as the surgical route.

Conclusions: Early removal of the urinary catheter <6 hours post-hysterectomy seems to increase the risk of urinary retention and needing re-catheterisation, but may reduce post-operative UTI.

Keywords: Hysterectomy, catheter, urinary, postoperative retention, systematic review.

Introduction

Hysterectomy is one of the commonest benign gynaecological procedures worldwide (1,2) with more than 400,000 hysterectomies performed in the USA yearly (3). Maintaining an empty bladder during surgery is common practice to reduce the risk of urological complications and promote enhanced post-operative recovery. Still, the optimal timing for post-operative catheter removal remains unclear (4). Delayed removal of urinary catheter postoperatively has been linked to increasing the risk of urinary tract infection (UTI), use of antibiotics, longer time to ambulation and hospital stay. In contrast, early removal (<6 hours post operatively) could also increase the risk of post-operative urinary retention and re-catheterisation (5,6).

A previous systematic review suggested that early catheter removal reduced the incidence of postoperative UTI, positive urine culture, and the time to ambulation; however, it increased the rate of re-catheterisation (7). This review, however, had several methodological limitations; it included a non-randomised study in the meta-analysis and incorporated women who had gynaecological surgery without a hysterectomy. Since its publication, two newer trials were published (355 women) reporting contradictory results (8,9). To evaluate the optimal time for removing the urinary catheter post-hysterectomy we conducted a systematic review and meta-analysis of all randomised trials on the topic.

Methods

We undertook this systematic review using a prospectively registered protocol (CDR 42019132213) and reported in accordance with the PRISMA guidelines.

Literature Search

We searched major electronic databases (MEDLINE, EMBASE and Cochrane CENTRAL) for all randomised trials evaluating the timing of catheter removal following hysterectomy from inception until May 2019. We combined the following MeSH search terms using the Boolean operators to screen for relevant studies ("hysterectomy", "catheter", "catheters, indwelling", "urine", "urinary retention") (Appendix 1). No search filters or language restrictions were applied. We manually searched the bibliographies of relevant articles to identify any additional studies not captured in the electronic search.

Study Selection

Two independent reviewers (MPR and IH) completed the study selection and inclusion process in two stages. Any discrepancies were discussed and resolved in consensus with a third reviewer (BHA). First, we screened titles and abstracts to identify potentially relevant studies. Then, we reviewed the full texts of relevant articles against our inclusion criteria. We included all primary randomised trials evaluating early versus delayed catheter removal in women who underwent a hysterectomy via any modality (abdominal, laparoscopic or vaginal). We excluded non randomised studies, animal studies, and review articles.

Data Extraction

Two reviewers (MPR and IH) extracted data in duplicate using a piloted electronic data extraction tool. We collected data on study design, number of participants, inclusion and exclusion criteria, length of catheterisation, clinical outcomes (symptoms of UTI, positive urinalysis, positive urine culture, antibiotic administration for UTI, post-operative pyrexia, re-catheterisation, time to ambulation (hours) and length of hospital stay (days)). Our primary outcome was post-operative urinary retention following the removal of catheter. We also reported on the following secondary outcomes which were planned *a priori:* post-operative

pyrexia and time to ambulation, length of hospital stay, positive urine culture, and UTI as a composite outcome of urinary symptoms and/or use of antibiotics (10).

Assessment of risk of bias

The quality of published literature was assessed by two reviewers in duplicate (MPR and IH) using the Cochrane Risk of Bias assessment tool. Studies were assessed in five domains: randomisation and sequence generation, allocation concealment, outcome assessment, completeness of outcome data, and selective outcome reporting. Due to the nature of the intervention, we did not penalise unblinded trials, none of the trials blinded assessors.

Data synthesis

We reported on dichotomous outcomes using summary risk ratio (RR) with 95% confidence intervals (CI) and on continuous outcomes using weighted mean difference (WMD). We pooled data using a restricted maximum likelihood (REML) random-effect model (11). We assessed the heterogeneity among included trials using the I^2 statistics. We planned a sensitivity meta-regression analysis to investigate potential effect modifiers where relevant. All statistical analyses were conducted in Stata V13 (StataCorp, TX) and Open Meta-analyst software (Brown University; Providence, RI, USA).

Results

Characteristics of included studies

Our electronic search identified 1020 potentially relevant citations, of which 15 articles were deemed relevant and were assessed in full. We excluded five studies: three studies reported incomplete data, one reported on women undergoing pelvic surgery (8) and one was a non-randomised study (12). In total, we included ten trials reporting on 1120 women who

underwent a hysterectomy (9,13–21) (Figure 1). Three studies were conducted in the USA and one study in each of the UK, Netherlands, Egypt, Italy, Hong Kong, India and Taiwan. All studies randomised women to either early catheter removal (<6 hours post-operatively) or delayed removal (>6 hours post-operatively), which ranged from 6 to 48 hours (Table 1). The median sample size of the included trials was 124 (range 70-250). There were variations in the surgical routes to perform hysterectomy with four trials reporting on abdominal hysterectomy (4/10, 40%), two on laparoscopic or laparoscopy assisted hysterectomy (2/10, 20%), one on vaginal hysterectomy (1/10, 10%) and three on any surgical route (3/10, 30%). Seven trials reported given prophylactic antibiotics pre-operatively (7/10, 70%) while three did not report on it.

Risk of Bias

The overall quality of the included studies was moderate (Figure 2, Appendix 2). Four studies had low risk of bias for randomisation and allocation concealment (4/10, 40%). Half of the included trials had low risk of bias for both outcome assessment and selective reporting (5/10, 50%), and majority had low risk of bias due to incomplete data (9/10, 90%) (Figure 2).

Outcomes

Compared to delayed removal, women in the early catheter removal group had a higher risk of urinary retention and needing re-catheterisation (10 RCTs, RR 3.61, 95%CI 1.21-9.21, I^2=56%). There was some reduction in the risk of post-operative UTI (6 RCTs, RR 0.42, 95%CI 0.18 to 0.96, I^2=0%), but we did not find a significant difference in post-operative pyrexia (6 RCTs, RR 0.73, 95%CI 0.43-1.24, I^2=18%) or positive urine cultures (6 RCTs, RR of 0.56, 95%CI 0.27-1.12, I^2=55%). There was no significant difference in the average time

to ambulation (3RCTs, WMD -4.6, 95%CI -9.16 to -0.18, I^2=98%) and length of hospital stay (3RCTs, WMD -1.05, 95%CI -2.42 to 0.31, I^2=98%) in both groups.

We performed a meta-regression to evaluate the effect of prophylactic antibiotics on reported outcomes. There was no significant effect on urinary retention (p=0.54), post-operative UTI (p=0.30), positive urine cultures (p=0.58), or post-operative pyrexia (p=0.34). A meta-regression was not possible for the two remaining outcomes due to the small sample size.

Discussion

Summary of findings

Our meta-analysis indicates that early removal of urinary catheter (<6 hours) post-hysterectomy might reduce the risk of post-operative UTI, however, it appears to increase the risk of urinary retention needing re-catheterisation. There were no obvious benefits in other reported measures including reducing time to mobilisation and the length of hospital stay. In view of the cumulative evidence on the potential adverse effects of early catheter removal, we deduce that such practice should not be routinely offered to women pending future research.

Strengths and limitations

We conducted this systematic review using a prospectively registered protocol and a standardised methodology. We assessed the risk of bias in included studies and extracted data in duplicate. We only included randomised trials and reported on clear time points (removal of catheter before and after 6 hours) to reduce selection and performance bias.

Our findings are not without limitations. Women included had different background morbidity and underwent different operative route for hysterectomy. The increased pain

associated with open abdominal surgery might lead to a higher risk of urinary retention in contrast to laparoscopic hysterectomy. Several trials provided intravenous or intramuscular antibiotics at the start of the surgery which could also reduce the risk of developing a UTI postoperatively and the sensitivity of urine cultures.(Table 1) This varied across included studies (using 1g ceftriaxone , 1.2g augmentin , 500mg cefazolin , 2g cefazolin or doxycycline), still, our meta-regression did not show a significant effect of antibiotics on the reported outcomes. The definition of UTI adopted by most authors was pragmatic including symptoms and use of antibiotics. While this is consistent with established guidelines (10), adopting a more stringent definition might reduce the event rate in both comparison groups.

The size of the urinary catheter used and the insertion technique were poorly reported which could impact our estimates. Other factors such as the duration of the anaesthesia, the operating time, and the post-operative pain relief could also impact the women's ability to pass urine after removing the catheter. The threshold of 6 hours used by most authors is somewhat arbitrary and the duration for delayed removal and the time of re-catheterisation varied across included trials. Our inferences are subject to the inherent, unavoidable heterogeneity in our meta-analyses. We believe our findings present the best available pragmatic evidence to advise clinical practice pending future studies.

Implications for future practice

With the increasing numbers of minimally invasive interventions in gynaecology, adopting the principles of enhanced recovery and early mobilisation is key to improve operative outcomes and meet the patients' expectation for a speedy recovery (4). Early removal of the urinary catheter is becoming routine practice especially since the introduction of same-day discharge following laparoscopic hysterectomy (22). However, our findings suggest that

removing the catheter before 6 hours might increase post-operative complications. Therefore, careful mitigation of peri-operative factors (planned time of discharge, length of the procedure, patient co-morbidity, etc.) remains essential to formulate a safe and optimal post-operative care plan (23,24).

Traditionally, prolonged and repeated catheterisation was deemed to be a contributing factor for post-operative UTIs. Still, the overall estimate in our meta-analysis shows minimal benefit of early vs delayed removal of catheter. Arguably, using an aseptic catheterisation technique with prophylactic IV antibiotic cover after anaesthetic induction and removal of the catheter less than 12 hours post-op might offer the optimal practice to reduce the risk of UTIs and post-operative pyrexia (25,26).

Future large trials are needed to evaluate the role of catheter removal in women planned for same-day discharge following total laparoscopic and laparoscopy assisted hysterectomy given their increased frequency and the potential for higher complications with early discharge. Future studies showed take into account the various effect-modifiers identified in this systematic review to aid translation into clinical practice.

Conclusions

Early removal of the urinary catheter (<6 hours) post-hysterectomy seems to increase the risk of urinary retention needing re-catheterisation with some reduction in the risk of UTI.

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Table 1: Characteristics of included trials comparing early vs delayed removal of urinary catheter post hysterectomy

Study	Country	Numbers randomised	Inclusion Criteria	Exclusion Criteria	Use of prophylactic Antibiotic
Sandberg 2018	Netherlands	155	> 18 years old undergoing laparoscopic hysterectomy	Additional procedures to hysterectomy Incontinence	Not reported
Ahmed 2014	Egypt	221	Undergoing total abdominal hysterectomy	Neurological disorders, Pre-operative UTI, surgeons decision for catheter to remain longer than cohort assignment, urge incontinence	1g Intramuscular ceftriaxone
Dunn 2003	USA	250	Undergoing a hysterectomy	Anticipated complicated procedure Additional bladder procedure during hysterectomy	Single dose of unspecified antibiotics prophylaxis before the operation
Alessandri 2006	Italy	96	Undergoing a hysterectomy	Anticipated complicated procedure, Recurrent UTI Urinary incontinence, Neurological disorders	Single dose of unspecified antibiotics prophylaxis before the operation
Chai 2011	Hong Kong	70	Undergoing total abdominal hysterectomy	Recurrent UTI, urinary incontinence, neurological disorders, surgeons decision for catheter to remain, spinal anaesthesia and patient controlled analgesia	Not given
Lang 2018	USA	200	Undergoing hysterectomy via any surgical route and expected to be hospitalized for at least one day	None reported	Not reported
Dobbs 1997	UK	95	Undergoing total abdominal hysterectomy for non-malignant reasons	None reported	1.2 g IV augmentin or alternative regime if allergic to penicillin
Liang 2009	Taiwan	150	Laparoscopic assisted vaginal hysterectomy	Pelvic reconstructive surgery, stress incontinence, Urinary symptoms	500mg iv cefazolin
Summitt 1994	USA	99	Undergoing a vaginal hysterectomy	Procidentia, Stress incontinence, positive urine culture	2g Iv cefazolin or 200 mg IV doxycycline if penicillin allergic
Joshi 2014	India	70	Undergoing abdominal hysterectomy	Anticipated complicated procedure, bladder suspension/Colporrhaphy surgery, positive urine culture, co-morbidities requiring fluid balance	at the time of surgery and continued postoperatively as per department protocol.

Figure legends:

Figure (1): Selection and inclusion process for trials in the systematic review comparing early vs delayed removal of urinary catheter post hysterectomy

Figure 2: Risk of bias in included randomised trials comparing early vs delayed removal of urinary catheter post hysterectomy

Figure (3): Forest plots of random effect meta-analyses for reported outcomes in trials comparing early to delayed removal of the urinary catheter post hysterectomy