Review Article

Is Bladder Training by Clamping Before Removal Necessary for Short-Term Indwelling Urinary Catheter Inpatient? A Systematic Review and Meta-analysis

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Purpose: Urinary catheterization is a common technique in clinical practice. There is, however, no consensus on management prior to removal of the indwelling catheter for short-term patients. This systematic review examined the necessity of clamping before removal of an indwelling urinary catheter in short-term patients.

Methods: A systematic literature review was conducted using eight databases and predetermined keywords-guided searches. Some 2,515 studies were evaluated. Ten studies that met the inclusion criteria were selected.

Results: The quality of the studies was assessed using the Jadad scoring system. Only 40.0% of studies were rated as high quality. This review found that catheter clamping prior to removal was not necessary for the short-term patient. When made a comparison with the unclamping group, there was no significant difference in recatheterization risk, risk of urine retention, patients’ subjective perceptions and rate of urinary tract infection.

Conclusions: This review indicated that bladder training by clamping prior to removal of urinary catheters is not necessary in short-term catheter patients. In addition, clamping carries the risk of complications such as prolonging urinary catheter retention and urinary tract injury. Further investigation requires higher quality methodologies and more diverse study designs.

Introduction

Use of an indwelling urinary catheter is very common in clinical practice. At least 15.0%–25.0% of inpatients have indwelling urethral catheters, mostly on a short-term basis [1–3]. Urinary catheters provide some information about physical function, but also increase the chances of infection. Approximately 40.0% of nosocomial infections originate from the urinary tract [4], and 80.0% occur after placement of urinary catheters. Some 20.0%–50.0% of patients whose urinary catheter remained in place for more than 1 week were found to have bacteriuria [3,5], and prolonged urinary catheter use increased bacteriuria by 3.0%–10.0% per day [3,6–8]. The most important risk factor for developing a catheter-associated urinary tract infection (UTI) was prolonged use of an indwelling catheter. This increased the risk of infection and the medical costs associated with infection treatment, prolonged patients’ hospital stay, and was potentially life threatening [3]. Centers for Disease Control recommended in 2015 [9] that urinary catheters should only be used for appropriate indications and should be removed as soon as they are no longer needed.

Difficulty in voiding after removal of the catheter, especially in aging patients with poor bladder contractile function, is another concern. Clamping the indwelling urinary catheter before removal was first recommended by Ross in 1936 [10]. The clamping process is
supposed to strengthen the bladder detrusor muscle, improve muscle tone and sensation of the bladder, and stimulate normal filling and emptying of the bladder [11,12]. There are, however, several disadvantages to clamping, such as bladder over distension if the clamping lasts too long [11], increased rate of re-indwelling by up to 1.06 fold per indwelling urinary day [13], increased duration of retaining the indwelling catheter and infection rate [11,14,15].

No clear guideline for bladder clamping has been listed in clinical practice. Each practitioner makes their own decision to clamp the catheter or not before removal based on their opinions of necessity. Cochrane reviews and some trials showed insufficient evidence that support the effectiveness of clamping in short-term indwelling catheter patients [1,6]. In addition, the Healthcare Infection Control Practices Advisory Committee (HICPAC) [16] and the Joanna Briggs Institute (JBI) [17] showed that, in order to prevent catheter-associated UTI, clamping indwelling catheters prior to removal provided weak evidence, as the poor quality of methodology in these studies was the major reasons [6,18].

Clearly, the necessity of clamping the urinary catheter before removal still is an important issue needing to be explored. Does clamping intervention before removal improve bladder function? Does it prolong return to normal voiding or prolong catheter retention? Research evidence to support the management of removal of urinary catheters are needed through systematic research and quality appraisal. The purpose of this systematic review was to identify the necessity of bladder clamping prior to removal of urinary catheter in patients with short-term indwelling catheter.

Methods

Review questions

The “participant, intervention, comparison and outcome” or PICO principle was used to formulate clinical questions that guided the search strategy, as shown in Table 1. The main research question was “What are the effects of urinary catheter clamping in short-term inpatients with the indwelling catheter?”

Search strategy

Search terms (Table 1) were selected using keywords from previous studies and dictionaries of Medical Subject Headings (MeSH terms); truncation symbols were used to broaden the search strategy. Eight databases were independently searched: Medline, EMBASE, CINAHL, PubMed, PsycINFO, ProQuest, Chinese Electronic Periodical Service and the Cochrane Controlled Trials Register. Search filters included English or Chinese language, and adult participants. The search was also limited to papers published prior to May 2016. Citation search of relevant published studies and systematic reviews were also used to locate relevant studies that may have been missed in the strategy described above.

Selection criteria for studies

Studies were eligible for inclusion if they met the following criteria: (a) randomized controlled trials or quasiexperimental study design; (b) urinary catheter was inserted in adult inpatients for up to 14 days; (c) with indwelling transurethral or suprapubic urinary catheters; and (d) conducted an intermittent clamping regimen. The exclusion criteria were as follows: (a) patients with congenital abnormalities of the genitourinary system; (b) received intermittent catheterization; (c) combined with drug treatment (including medication affecting bladder contraction, prophylactic antibiotics for UTI); (d) receiving pelvic floor exercise, or filling fluid into the bladder; (e) removal of nephrostomy tubes; and (f) relevant procedure not clearly reported.

Quality assessment of selected studies

Each of the two authors independently evaluated the quality of methodology by the Jadad scoring system and the risk of bias in each study. The possible range of Jadad scores was 0–5, and a score of 3–5 indicated high quality [19].

Data extraction and management

After confirming the eligibility of studies, two reviewers independently extracted the data from the included studies. The parameters extracted for each study included: study reference (author, year of publication), study design, setting, participants (number, mean age), types of interventions, types of control group, and outcome measures. The findings are summarized in Table 2.

<table>
<thead>
<tr>
<th>Key element</th>
<th>Description</th>
<th>Search terms</th>
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<tbody>
<tr>
<td>Population</td>
<td>Adult inpatient</td>
<td>Indwelling urinary catheter up to 14 days.</td>
</tr>
<tr>
<td>Intervention</td>
<td>Regular clamp on urinary catheter and clamp off before removal</td>
<td>Foley catheter clamping/Urinary catheter on and off/Urinary catheter clamp and releaser/Urinary catheter close and open/Clamping urinary catheter/Urethral catheter clamping/Urethral catheter clamp and releaser/Urethral catheter close and open</td>
</tr>
<tr>
<td>Comparison</td>
<td>Keeping the urinary catheter on free draining until removal</td>
<td>Catheterization, Urethral/Urethral catheterization/Foley catheterization/Catheterization, Foley</td>
</tr>
</tbody>
</table>

Note. PICO – participant, intervention, comparison and outcome. * denotes the truncation to explore the potential references.
Quantitative data synthesis

Data were synthesized by Review Manager (RevMan, Version 5.1) (The Nordic Cochrane Centre, The Cochrane Collaboration, Copenhagen). This software was used to examine data homogeneity and calculate intervention differences. Tests for homogeneity were performed to evaluate similarities between studies with p value greater than .05 demonstrating acceptable homogeneity. If there is homogeneity, we used a fixed effect model, or for heterogeneous studies, we used a random effect model to combine data in the meta-analysis. Dichotomous data were calculated by the odds ratio (OR) and 95% confidence intervals (CI), and continuous data calculation used mean and standard deviation values. A p value of less than .05 was considered a statistically significant difference.

Results

A total of 2,515 abstracts was obtained by searching through the databases and 8 additional records were identified through other sources. After removing 96 duplicates, 2,395 articles were potentially relevant. After reviewing the titles and abstracts, 2,289 articles were excluded because they did not meet the inclusion criteria. The full texts of 106 studies were examined in detail; only 10 papers satisfied all the inclusion criteria and were therefore included in this review. Details of the selection process of included and excluded papers and retrieval of full text papers are shown in the PRISMA flowchart in Figure 1.

A total of nine trials and 927 participants were included in this review. One trial was a quasiexperimental study design and the others used an experimental design. The studies were published between 1981 and 2015. One trial included two control groups in comparison [20]. Four of the nine studies were conducted in the United States; the others were conducted in Sweden, Taiwan, the United Kingdom, Spain, Italy and China. Most participants were surgical patients or had undergone a surgical treatment [1,20–27]; only one trial involved stroke patients [28]. The operation sites were as follows: two studies were related to bowel cancer surgery [22,23]; one study was related to orthopedic surgery [1]; five studies involved urogynecology-related surgery [20,23–27]; one study did not mention the type of surgery [21]. There were 780 female participants (84.1%); one study only included male participants [28], while the other seven studies involved only female patients. The age range of participants was 23–84 years.

There was divergence in the use of the clamping urinary catheter intervention. Two study used Q3h clamping urinary catheter [21,27], another used Q4h [1] and three studies used progressive clamping intervention [23–25]. Five studies provided no detail about the clamping procedure [20,22,25–27]. The release interval ranged from 5 minutes [21,23] to 15 minutes [24,25]. As for the type of the indwelling urinary catheter, one study used a suprapubic catheter [22] and the others used a transurethral catheter. Time of clamping began at postsurgery as follows: first day [24,26], second day [1], third day [25,27] and fourth day [23]. The other studies did not specify the timing [20–22,28].

The measured variables varied. Seven studies reported recatheterization [1,20,22,23,25–27]. Time of first voiding after removal of the urinary catheter was reported in three trials [21,23,26]. The residual amount of the first voiding was reported in three studies [21,25,26]. Urinary retention was measured in four trials [1,2,20,22,25]. UTI was reported in six trials [1,20,22,24,25,27]. Most studies used urine culture to diagnose UTI; only two studies failed to specify how UTI was identified [1,20]. Patients’ subjective perception was also reported in five trials [21–23,25,26]. One study [23] reported that eight participants experienced frequent urination, but did not identify the group to which they belonged. The diversity in measured variables of patients’ subjective perception made meta-analysis impossible.

Methodological quality

Two reviewers independently evaluated the quality of methodology in each study by using the Jadad scoring system and the risk of bias. The possible range of Jadad scores was 0–5 and scores of 3–5 indicated high quality [19]. Jadad scores ranged from 1 to 4 in all included studies. In total, 40.0% of the studies attained a Jadad score as high quality, 50.0% of the studies are of medium quality, and 10.0% of the studies are of poor quality (Table 2).

Meta-analysis for outcomes

Recatheterization after removal of urinary catheter

Seven studies reported the need for recatheterization following removal of the urinary catheter [1,20,22,23,25–27]. This involved a total of 927 patients, all of whom had received surgical interventions. Figure 2 shows the effects of clamping on recatheterization. Homogeneity was achieved ($\chi^2 = 3.69$, $p = .595$). The recatheterization effect Z value was 1.68 [OR = 0.66, 95% CI (0.41, 1.07), $p = .493$]. There was no significant difference between the clamping and the unclamping group. Different clamping procedures were also compared. Only two studies related to the progressive clamping group [23,25]. Homogeneity was achieved ($\chi^2 = 0.96$, $p = .327$), and Z value was 1.65 [OR = 0.53, 95% CI (0.25, 1.13), $p = .099$]. Four studies used regular clamping technique [1,20,22,27]. Homogeneity was achieved ($\chi^2 = 2.23$, $p = .526$) and Z value was 0.80 [OR = 0.77, 95% CI (0.42, 1.44), $p = .424$]. The results showed that there was no difference between these two types of clamping intervention in relation to recatheterization.

Timing of first voidings

The timing of the first voiding was reported in three studies [21,23,26]. One study reported the mean of timing for the first voiding (1.92 hours) in the clamping group and free draining (2.72 hours) group ($p < .05$) [21]. No further data could be obtained. Therefore, only two studies were included in meta-analysis. However, high heterogeneity ($\chi^2 = 9.84, p = .002, I^2 = 90\%$) and Z value at 0.93 [Mean Difference, (MD)-53.81, 95% CI (-167.71, 60.09), $p = .346$] meant that meta-analysis was not a suitable choice.

UTI

Six studies reported the occurrence of UTI [1,21,22,24,25,27]. This diagnosis was identified by urine culture in 4 trials [21,22,24,25], and two study failed to specify the diagnostic procedure [1,27]. All studies were conducted on surgical patients. Homogeneity was achieved ($\chi^2 = 0.61, p = .976$) and Z value was 1.22 [OR = 0.73, 95% CI (0.43, 1.21), $p = .271$] (Figure 3). No significant difference between clamping and unclamping group was found. Furthermore, different clamping procedures were compared. Two studies used the progressive clamping technique [23,25]. Homogeneity was achieved ($\chi^2 = 0.07, p = .801$) and Z value was 0.89 [OR = 0.74, 95% CI (0.38, 1.44), $p = .373$], whereas four studies used regular clamping techniques [1,20,22,27]. Homogeneity was achieved ($\chi^2 = 0.74, p = .864$) and Z value was 0.65 [OR = 0.76, 95% CI (0.33, 1.73), $p = .516$]. These results indicated that no significant difference in UTI was found between these two clamping interventions.
<table>
<thead>
<tr>
<th>First author, year &amp; country</th>
<th>Patients</th>
<th>Duration of indwelling</th>
<th>Sample size</th>
<th>Intervention description</th>
<th>Main findings</th>
<th>Jadad score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oberst 1981 USA [23]</td>
<td>Bowel cancer patients</td>
<td>6 d</td>
<td>52 58</td>
<td>EG: Clamp schedule from postsurgery day 4 to day 10, remove progressive clamping; each clamping has a 5-min release drainage. CG: Free draining and removed on postoperative day 10.</td>
<td>1. Voiding dysfunction: EG had lower voiding dysfunction rate than CG did at removal of catheter immediately &amp; at discharge. 2. First voiding time: EG had shorter first voiding time than CG did.</td>
<td>3</td>
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<tr>
<td>Williamson 1982 USA [21]</td>
<td>Ongoing surgery female patients &amp; indwelling catheter for at least 36 h</td>
<td>NA</td>
<td>4 4</td>
<td>EG: Q3H clamping then release for 5 min. CG: Free draining.</td>
<td>1. First voiding time: EG had shorter first voiding time than CG did. 2. Residual urine amount: EG had less residual urine than CG did. 3. Patients' perceived symptoms: In EG, 1 patient felt burning &amp; 2 complained of bladder filling during the first voiding but did not feel pressure or pain. In CG 1 patient experienced bladder and sphincter spasm.</td>
<td>2</td>
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<tr>
<td>Bergman 1987 USA [24]</td>
<td>Urodynamic stress urinary incontinent</td>
<td>CG: 3.4 d EG: 3.5 d</td>
<td>44 45</td>
<td>EG: Clamping schedule from postsurgery day 1, progressive clamping &amp; each clamping has a 15-min release drainage. CG: Free draining.</td>
<td>1. Length of catheterization: EG was similar to CG in retention time of urinary catheter. 2. UTI: EG had higher rate than CG.</td>
<td>3</td>
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<tr>
<td>Guzman 1994 Spain [20]</td>
<td>Undergoing vaginal surgery</td>
<td>CG 1: 24h CG2: 72h EG: NA</td>
<td>33 103</td>
<td>EG: Indwelling catheter within 72 h &amp; clamping. CG 1: Free draining &amp; removal after 24 h. CG 2 : Free draining &amp; 72 h remove.</td>
<td>1. UTI: CG2 had the highest rate; CG 1 was the same as EG. 2. Urinary retention: EG had higher rate than CG, CG2 was higher than CG1.</td>
<td>2</td>
</tr>
<tr>
<td>Ratnaval 1996 UK [22]</td>
<td>Pelvic colorectal surgery, male patients</td>
<td>EG: 7.2 d CG: 7.5 d</td>
<td>24 26</td>
<td>EG: Suprapubic catheter clamped prior to removal; remove catheter at a residual volume of &lt; 50 mL. CG : Transurethral catheter with free draining.</td>
<td>1. Mean catheter retention time: No difference between groups. 2. Complications: EG had fewer complications in urine retention, frequent voiding, recatheterization &amp; UTI.</td>
<td>2</td>
</tr>
<tr>
<td>Sun 2004 Taiwan [25]</td>
<td>Genuine stress incontinent</td>
<td>EG: 5 d CG: 1 d</td>
<td>43 43</td>
<td>EG: Clamping schedule from postsurgery day 3, clamp for 1 h 45 min &amp; release for 15 min until day 5. CG: Remove on postsurgery day 1.</td>
<td>1. Voiding difficulty: EG patients experienced more voiding difficulty than CG did. 2. Bacteriuria: EG patients had more than CG did. 3. Felt incomplete emptying or voiding frequency &amp;/or urgency: Both groups the same. CG had more frequency &amp;/or urgency than EG did. 4. Recatheterization: CG had higher rate than EG did.</td>
<td>2</td>
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patients' subjective perceptions of voiding-related symptoms

Four studies measured patients' subjective perceptions of voiding-related symptoms after removal of the urinary catheter [21,22,25,26]. All participants were surgical inpatients. Two studies reported the perceptions of urinary frequency and/or urinary urgency [22,25], one reported incomplete voiding [25], one mentioned burning sensation, spasms or filling during voiding [21], and one only documented discomfort during voiding [26]. We excluded one study with wide variation [21]. Then, the homogeneous results were obtained ($\chi^2 = 4.07$, $p = .131$, $I^2 = 51\%$) and Z value was 1.91 [OR = 0.53, 95% CI (0.28, 1.02), $p = .056$] (Figure 4). It showed that clamping made no significant difference on patients' subjective perceptions of voiding-related symptoms.

Urinary retention

Four studies reported incidence of urinary retention [1,2,22,25]. Three of these studies involved abdominal or pelvic-related surgery [20,22,25], and one involved orthopedic surgery [1]. Two studies were excluded due to wide variation [1,25], and only two studies were retained in this analysis. Homogeneity was achieved ($\chi^2 = 0.65$, $p = .420$), Z value was 0.91 [OR = 1.39, 95% CI (0.68, 2.84), $p = .363$] (Figure 5). Results of these limited studies showed that there was no significant difference in the incidence of urinary retention between these two groups.

Discussion

Bladder training encourages people to extend the time between voiding and regain continence ability. In some cases, were found bladder training could improve voiding function in patients with long-term indwelling catheter or incontinence. In clinical situation, we indwelling urinary catheter for some purpose. They almost are short-term indwelling. It's confusion from limited scientific literature to known the necessity of clamping in short-term indwelling patients. This systematic review was undertaken to investigate the necessity of clamping short-term indwelling catheter before its removal in adult patients. Ten studies were included in our analysis. Half of the studies were included in our analysis. Half of them were published before 2000's, and the others were published after 2000's. The results of the limited studies showed that no significant differences between clamping and unclamping groups existed in relation to risk of recatheterization, urine retention, subjective symptoms related to voiding, and the rate of UTI. Compared with the systematic review done by Griffiths and Fernandez [6], we included 10 studies with 927 participants and added two clamping strategies to make comparison. Similar results were found in the present analysis. From the limited evidence found here, the recommendations from HICPAC and JBI, that clamping indwelling catheters prior to removal was not necessary nowadays were again supported. The use of indwelling catheters is very common in clinical practice. During indwelling, the muscle and the sphincter of the bladder is at rest. For the longest time, it needs to be re-stimulated by training to recover its physical function [12]. Some studies showed that clamping intervention could strengthen the detrusor muscle, improve muscle tone and bladder sensation, and stimulate normal filling and emptying of the bladder [11,12]. Others, however, concluded that clamping training increased duration of the indwelling catheter, infection rate and cost in cases of short-term indwelling catheter [14,15,30]. It is still a confusing situation for both patients and healthcare providers.
2,515 potentially relevant articles identified through a literature search:
- 34 in CINAHL/149 in Medline
- 1,654 in ProQuest/128 in PubMed
- 476 in Chinese Electronic Periodical
- 74 EMBASE

8 additional records identified through other sources.

128 duplicates removed

2,395 potentially relevant articles
Records screened

2,289 excluded by review of titles & abstracts (did not meet inclusion criteria).

96 articles excluded:
- 5 Measured medicine effect; 17 Survey; 3 Measured lab outcome; 4 Systematic review; 14 Narrative; 6 Compared difference in removal time; 9 Not English or Chinese language; 4 Pediatric participants; 1 Lack of control group; 16 Study did not contain outcomes of interest; 12 No clear trial procedure; 5 Exercise effect; 1 Used Filling bladder by fluid; 1 Compared clamping catheter verse ICP; 8 Non clinical trial; 4 non clarity intervention and data outcome.

106 full-text articles assessed for eligibility

10 articles included in analysis

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This review included studies involving pelvic and intestinal surgery patients. These surgical sites are more susceptible to limited muscle exertion during urination. Our results showed that clamping had no impact on the main selected outcomes. Similar findings have been reported for urinary catheter clamping in patients undergoing gynecologic surgery, that is, the procedure had no effect in preventing urinary retention and urinary infection [29].

Clamping programs were divided into two groups: progressive clamping procedure and regular clamping interval. Our advanced analysis found that there was no difference between these two clamping programs in relation to recatheterization. Since only one study examined progressive clamping with urinary retention, further inference was not possible. Some researchers, however, have argued that progressive clamping was beneficial for urinary function [12].
Figure 2. Forest plot for recatheterization. Note. CI = confidence interval.

Figure 3. Forest plot for urinary tract infection. Note. CI = confidence interval.

Figure 4. Forest plot for patients’ perceptions of voiding-related symptoms. Note. CI = confidence interval.
This review indicated that the clamping group had a longer duration of urinary catheterization than the unclamping group. Prolonged duration of retention increased the risk of complications from catheterization [30]. At the same time, the use of clamping could increase both the workload of nurses and the potential risk of bladder/urinary system injury due to failure to reopen it.

This review had several limitations. First, less than half of the studies were regarded as high quality. These methodological shortcomings limited the availability of evidence. Second, some studies did not provide detailed descriptions of the intervention procedure, and some data were unavailable. The review may, therefore, be limited by publication bias. Third, only one study included nonsurgical patients, which restricted the ability to draw inferences to other medical patients.

Conclusion

We explored the issues of clamping indwelling urethral catheters before removal based on limited evidence. From our review, no significant difference was found between the clamping and unclamping groups in the outcomes of recatheterization, urinary retention, UTI and patients’ subjective perceptions of voiding-related symptoms. The limited evidence obtained from this review does not provide a robust base to overrule the existing guidelines.

Implications for practice and research

The results provided weak evidence that catheter clamping before removal is not necessary in short-term inpatients. It supported the guideline proposed by HICPAC and JBI that clamping indwelling catheters prior to removal is not necessary. In managing short-term indwelling catheter patients, if there is no indicator for continued use of a urinary catheter, nurses should unplug the catheter earlier to reduce potential complications. Still, nurses and other healthcare providers need to monitor patients’ urination and assess bladder fullness closely after removal of the catheter.

The low quality in methodology and the nature of study populations in the original studies limited the applicability of our review. For further study, studies designed with high quality (i.e., randomized controlled trials), patients with various diagnosis, and multicenter trials were strongly suggested.

Conflicts of interest

The authors have no conflict of interest to declare.

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References


