Review Article

# Urinary catheterization and techniques for preventing hematuria: integrative review

## Cateterismo urinário e as técnicas para prevenção de hematúria: revisão integrativa

## Cateterismo urinario y las técnicas para prevención de hematuria: revisión integradora

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## Abstract

**Objective:** Analyze and synthesize the available scientific evidence on urinary catheterization and techniques used to prevent hematuria in bladder emptying and acute and chronic urinary retention in adults and the elderly.

**Methods:** This integrative review was carried out in the PubMed, LILACS, Embase, Cochrane, Web of Science, and Scopus databases. Hand searching was used in the reference lists of included studies. An unlimited period was used to review the studies published in Portuguese, English, French, German, and Spanish. The PICOS strategy was applied to develop the research question and the *Joanna Briggs Institute* (JBI) instrument was used to assess the methodological quality of studies.

**Results:** Eleven studies were included, with a total of 659 patients. Urinary retention occurred mainly in men and the main cause was benign prostatic hyperplasia. Rapid and gradual decompressions were the techniques used for bladder decompression by urinary catheterization, and hematuria and hypotension were the main complications regardless of the technique. The results showed that there was no significant difference between the two techniques in terms of the outcome of hematuria prevention.

**Conclusion:** Gradual bladder emptying does not prevent hematuria compared to rapid and complete emptying. Case reports describe clinical conditions that deserve attention when hematuria occurs after urinary catheterization and the respective implications in the treatment of patients. We highlight the importance of nursing in identifying and preventing the diagnosis of Urinary Retention to avoid subsequent interventions and clinical complications, including post-catheterization hematuria.

## Resumo

**Objetivo:** Analisar e sintetizar as evidências científicas disponíveis sobre o cateterismo urinário e as técnicas utilizadas para prevenir a hematúria no esvaziamento da bexiga, na retenção urinária aguda e crônica, em adultos e idosos.

**Métodos:** Revisão integrativa realizada nas bases de dados Pubmed, LILACS, Embase, Cochrane, Web of Science e Scopus; e busca manual nas listas de referências dos estudos incluídos. Um período ilimitado foi usado para revisar estudos em português, inglês, francês, alemão e espanhol. Aplicado estratégia PICOS na elaboração da pergunta de pesquisa e instrumento Joanna Briggs Institute (JBI) para avaliar qualidade metodológica dos estudos.

**Resultados:** Foram incluídos 11 estudos, com um total de 659 pacientes. A retenção urinária ocorreu principalmente em homens, tendo como principal causa a hiperplasia prostática benigna. As técnicas utilizadas para descompressão vesical, por cateterismo urinário, foram a descompressão rápida e a gradual,

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sendo as principais complicações, independente da técnica, hematúria e hipotensão. Os resultados mostraram que não houve diferença significativa entre as duas técnicas quanto ao desfecho prevenção da hematúria.

**Conclusão:** O esvaziamento gradual da bexiga não previne a hematúria em comparação com o esvaziamento rápido e completo. Mas os estudos, principalmente os relatos de casos, descrevem quadros clínicos que merecem atenção diante da ocorrência de hematúria após cateterismo urinário e as implicações no tratamento dos pacientes. Destaca a importância da enfermagem na identificação e prevenção do diagnóstico de Retenção Urinária, a fim de evitar intervenções posteriores e complicações clínicas, inclusive hematúria pós-cateterismo.

## Resumen

**Objetivo:** Analizar y sintetizar las evidencias científicas disponibles sobre el cateterismo urinario y las técnicas utilizadas para prevenir la hematuria en el vaciado de la vejiga, en la retención urinaria aguda y crónica en adultos y personas mayores.

**Métodos:** Revisión integradora realizada en las bases de datos Pubmed, LILACS, Embase, Cochrane, Web of Science y Scopus y búsqueda manual en las listas de referencias de los estudios incluidos. Se utilizó un período ilimitado para revisar estudios en portugués, inglés, francés, alemán y español. Se aplicó la estrategia PICOS en la elaboración de la pregunta de investigación y el instrumento Joanna Briggs Institute (JIB) para evaluar la calidad metodológica de los estudios.

**Resultados:** Se incluyeron 11 estudios con un total de 659 pacientes. La retención urinaria ocurrió principalmente en hombres, principalmente a causa de la hiperplasia prostática benigna. Las técnicas utilizadas para la descompresión vesical por cateterismo urinario fueron la descompresión rápida y la gradual, y las principales complicaciones, independientemente de la técnica, fueron hematuria e hipotensión. Los resultados mostraron que no hubo diferencia significativa entre las dos técnicas respecto al resultado de prevención de la hematuria.

**Conclusión:** El vaciado gradual de la vejiga no previene la hematuria en comparación con el vaciado rápido y completo. Sin embargo, los estudios, principalmente los relatos de casos, describen cuadros clínicos que necesitan atención ante los episodios de hematuria después del cateterismo urinario y las consecuencias en el tratamiento de los pacientes. Se destaca la importancia de la enfermería en la identificación y prevención del diagnóstico de retención urinaria, a fin de evitar intervenciones posteriores y complicaciones clínicas, inclusive hematuria poscateterismo.

## Introduction

Urinary Retention is defined as the complaint of inability to urinate or empty the bladder.[1] Its incidence is higher among men and increases with aging. At least one episode of Urinary Retention occurs in men aged between 70 (10%) and 80 (30%) years of age,[2] with the main cause being Benign Prostatic Hyperplasia (BPH). In women, impairment occurs especially due to changes in the urethra where a decrease occurs in urethral pressure.[3]

Urinary Retention can be classified as Acute Urinary Retention (characterized as a palpable and/or percussive painful bladder in the suprapubic region; these patients are unable to urinate) and Chronic Urinary Retention (characterized as a painless bladder that remains palpable and/or percussive after the patient urinates).[1] Acute cases of urinary retention may occur due to the use of medication or infection related to iatrogenesis. The most prevalent obstructive cause of urinary retention is related to BPH.[4-6]

The neurological causes of Urinary Retention are related to damage to pelvic nerves up to the sacral plexus, brain, and spinal cord.[7] Diabetes *Mellitus*, Guillain-Barré Syndrome, Parkinson's disease, and hemorrhagic or ischemic stroke (*e.g.*) may also be associated with Urinary Retention due to neurological involvement.[8]

The immediate treatment for patients with Urinary Retention is bladder decompression, which can be performed using urinary catheterization. In Intensive Care Units (ICU), 93.3% of patients use a bladder catheter for delays longer than 24 h.[9]

The procedural intervention of bladder catheterization is exclusive to professional nurses as it involves risks to patients; In addition, it requires technical-scientific knowledge and the ability to make more complex decisions to ensure safer care. The procedure can also be performed by physicians.[6,10]

In this context, the procedural intervention of urinary catheter insertion may be related to several complications; hematuria is a potential complication, which may occur due to urethral trauma at the time of urinary catheterization or due to structural changes in the renal system. The presence of visible blood in the urine has also been associated with rapid and complete emptying of the bladder after urinary catheterization, which is also known as "*ex vacuum*" hematuria.[11,12]

Such studies justify that blood vessels dilate and the bladder wall becomes flaccid with the increase in intravesical pressure during Urinary Retention. These vessels rupture when intravesical pressure de-

creases by draining urine or stopping bladder filling, causing hematuria.[13,14]

The two urinary catheterization technical interventions most cited and used for the treatment of Urinary Retention (which can prevent hematuria) are the rapid and complete bladder decompression techniques; *i.e.*, continuous emptying of urine through a urethral catheter and gradual decompression performed by clamping the urethral catheter, thus fractionating the amount of urine drained.[15] Taking care not to empty the bladder abruptly has been discussed for many years due to the increase in the number of prostate surgeries. Surgeons defended this care as an intervention to reduce risks. However, there was no scientific evidence since 1932 that gradual decompression prevented complications.[16]

Recently, a systematic review with meta-analysis was published aiming to synthesize evidence to verify the effects of rapid and gradual bladder decompressions and identify their complications in Urinary Retention. "The evidence indicated that blood pressure drops after decompression but without significant clinical complications. It was also concluded that rapid decompression does not result in risks of hematuria or severe hypotension compared to gradual decompression".[17]

Nurses are faced daily with issues related to their practices. Responding to them systematically and with excellence is necessary to promote the best care and optimize results in clinical practice.[17] Thus, an expanded search for recent scientific evidence and care is necessary to avoid complications related to urethral catheterization intervention and prevent hematuria in addition to rapid and gradual bladder decompression techniques and their outcomes. Therefore, the objective of this integrative review was to analyze and synthesize the scientific evidence available on urinary catheterization and the techniques used to prevent hematuria during bladder emptying in acute and chronic urinary retention in adults and the elderly.

## Methods

This systematic integrative review was carried out through the following steps: identification of the topic, selection of the research question (hypothesis), criteria for inclusion and exclusion of studies, literature search, extraction of data for analysis, critical evaluation of included studies, and interpretation and synthesis of results.[18]

Identification of the topic and Selection of the research question: After identifying the topic, the PICOS strategy was used to develop the guiding question of this review. The Study Population (P) was composed of adults and elderly people (aged ≥18 years) with acute or chronic Urinary Retention; they underwent Intervention (I) using urinary catheterization techniques to empty their bladders; Comparison (C) was not applied; prevention of hematuria was the Outcome, and primary studies were the Study Type (*Study Type*). Therefore, the question was as follows: What is the available evidence on urinary catheterization and the techniques used to prevent hematuria on bladder emptying in cases of acute and chronic urinary retention in adults and the elderly?

### Inclusion and exclusion criteria for studies

Primary studies carried out in adults and elderly with acute or chronic urinary retention undergoing bladder decompression using urinary catheterization techniques to prevent hematuria were the inclusion criteria of this review (with unlimited temporal scope). Suprapubic catheterization studies in languages other than the Latin-Roman alphabet (Japanese, Chinese, and Finnish) were the exclusion criteria.

### Literature search

The search was carried out on December 29, 2022, in the following databases: National Library of Medicine's (Pubmed), *Literatura Latino-Americana e do Caribe em Ciências da Saúde* (LILACS), Embase, Cochrane Central Register of Controlled Trials (Cochrane Library), Web Of Science, and Scopus (Elsevier). The choice of descriptors and/or keywords was based on the research question and was carried out by consulting the Descriptors in Health Science (DeCS) and MeSH descriptors combined with the Boolean operators "AND", "OR", and "NOT". The search strategy was adapted to the language of each database as shown in chart 1

**Chart 1.** Database search strategies

| |
|---|
| Pubmed: ("bladder catheterization"[All Fields] OR "bladder catheterizations"[All Fields] OR "urinary catheterization"[All Fields] OR "Urinary Catheterizations"[All Fields] OR "Ureteral Catheterizations"[All Fields] OR "Ureteral Catheterization"[All Fields] OR "Urethral Catheterizations"[All Fields] OR "Urethral Catheterization"[All Fields] OR "Foley Catheterization"[All Fields] OR "bladder catheterisation"[All Fields] OR (("bladder s"[All Fields] OR "urinary bladder"[MeSH Terms] OR ("urinary"[All Fields] AND "bladder"[All Fields]) OR "urinary bladder"[All Fields] OR "bladder"[All Fields] OR "bladders"[All Fields]) AND ("catheterisation"[All Fields] OR "catheterization"[MeSH Terms] OR "catheterization"[All Fields] OR "catheterisations"[All Fields] OR "catheterising"[All Fields] OR "catheterism"[All Fields] OR "catheterisms"[All Fields] OR "catheterise"[All Fields] OR "catheterised"[All Fields] OR "catheterizations"[All Fields] OR "catheterize"[All Fields] OR "catheterized"[All Fields] OR "catheterizing"[All Fields])) OR (("decompress"[All Fields] OR "decompressed"[All Fields] OR "decompresses"[All Fields] OR "decompressing"[All Fields] OR "decompression"[MeSH Terms] OR "decompression"[All Fields] OR "decompressions"[All Fields] OR "decompressive"[All Fields]) AND ("urinary tract"[MeSH Terms] OR ("urinary"[All Fields] AND "tract"[All Fields]) OR "urinary tract"[All Fields] OR "urinary"[All Fields])) OR "bladder decompression"[All Fields] OR ("decompress"[All Fields] OR "decompressed"[All Fields] OR "decompresses"[All Fields] OR "decompressing"[All Fields] OR "decompression"[MeSH Terms] OR "decompression"[All Fields] OR "decompressions"[All Fields] OR "decompressive"[All Fields])) AND ("haematuria"[All Fields] OR "hematuria"[MeSH Terms] OR "hematuria"[All Fields] OR "haematurias"[All Fields] OR "hematurias"[All Fields] OR ("haematuria"[All Fields] OR "hematuria"[MeSH Terms] OR "hematuria"[All Fields] OR "haematurias"[All Fields] OR "hematurias"[All Fields])). |
| Lilacs: ("bladder catheterization" OR "bladder catheterizations" OR "urinary catheterization" OR "Urinary Catheterizations" OR "Ureteral Catheterizations" OR "Ureteral Catheterization" OR "Urethral Catheterizations" OR "Urethral Catheterization" OR "Foley Catheterization" OR "bladder catheterisation" OR "bladder catheterisations" OR "decompression urinary" OR "bladder decompression" OR decompression) AND (hematuria OR haematuria) AND (db:("LILACS")). ("Cateterismo Urinário" OR "Vejiga Urinaria" OR Descompresión) AND (hematúria). |
| Embase: ('bladder catheterization':ti,ab,kw OR 'bladder catheterizations':ti,ab,kw OR 'urinary catheterization':ti,ab,kw OR 'urinary catheterizations':ti,ab,kw OR 'ureteral catheterizations':ti,ab,kw OR 'ureteral catheterization':ti,ab,kw OR 'urethral catheterizations':ti,ab,kw OR 'urethral catheterization':ti,ab,kw OR 'foley catheterization':ti,ab,kw OR 'bladder catheterisation':ti,ab,kw OR 'bladder catheterisations':ti,ab,kw OR 'decompression urinary':ti,ab,kw OR 'bladder decompression':ti,ab,kw OR decompression:ti,ab,kw) AND (hematuria:ti,ab,kw OR haematuria:ti,ab,kw). |
| Cochrane Library: ("bladder catheterization" OR "bladder catheterizations" OR "urinary catheterization" OR "Urinary Catheterizations" OR "Ureteral Catheterizations" OR "Ureteral Catheterization" OR "Urethral Catheterizations" OR "Urethral Catheterization" OR "Foley Catheterization" OR "bladder catheterisation" OR "bladder catheterisations" OR "decompression urinary" OR "bladder decompression" OR decompression) AND (hematuria OR haematuria) in Title Abstract Keyword - (Word variations have been searched). |
| Web of science: TÓPIC: ((«bladder catheterization» OR «bladder catheterizations» OR «urinary catheterization» OR «Urinary Catheterizations» OR «Ureteral Catheterizations» OR «Ureteral Catheterization» OR «Urethral Catheterizations" OR "Urethral Catheterization" OR "Foley Catheterization" OR "bladder catheterisation" OR "bladder catheterisations" OR "decompression urinary" OR "bladder decompression" OR decompression) AND (hematuria OR haematuria)) Tempo estipulado: Todos os anos. Índices: SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI. |
| Scopus: TITLE-ABS-KEY (("bladder catheterization" OR "bladder catheterizations" OR "urinary catheterization" OR "Urinary Catheterizations" OR "Ureteral Catheterizations" OR "Ureteral Catheterization" OR "Urethral Catheterizations" OR "Urethral Catheterization" OR "Foley Catheterization" OR "bladder catheterisation" OR "bladder catheterisations" OR "decompression urinary" OR "bladder decompression" OR decompression ) AND ( hematuria OR haematuria ). |

### Data extraction

The articles collected in each database were exported to the EndNote (2020; online version) software for organized viewing and identifying and deleting duplicate studies. Then, the studies were exported to the Rayyan platform. Two reviewers developed the first selection stage independently and blindly by reading the titles and abstracts of these studies and applying the eligibility criteria. Conflicts identified in the selection were resolved by a third reviewer. A manual search of the references of the included articles was also carried out after full reading. The manual search inclusion criteria were the same as those used for selection in the databases.

### Critical evaluation of studies

The Joanna Briggs Institute (JBI) instrument was used to critically evaluate the studies included in this review. The instrument uses the greatest number of "yes" responses as an indicator of the best methodological quality of the study.[19] The studies were also classified according to their strength of evidence based on the clinical question using the scale proposed by Melnyk and Fineout-Overholt (2019).[20]

### Interpretation of results

After collecting data from the articles, different methodological designs and results were identified, interpreted, and then presented descriptively.

### Summary of results

The urinary catheterization techniques used in cases of acute or chronic urinary retention and their relationship with the occurrence of hematuria and its complications (as well as approaches for clinical practice) were listed and analyzed.

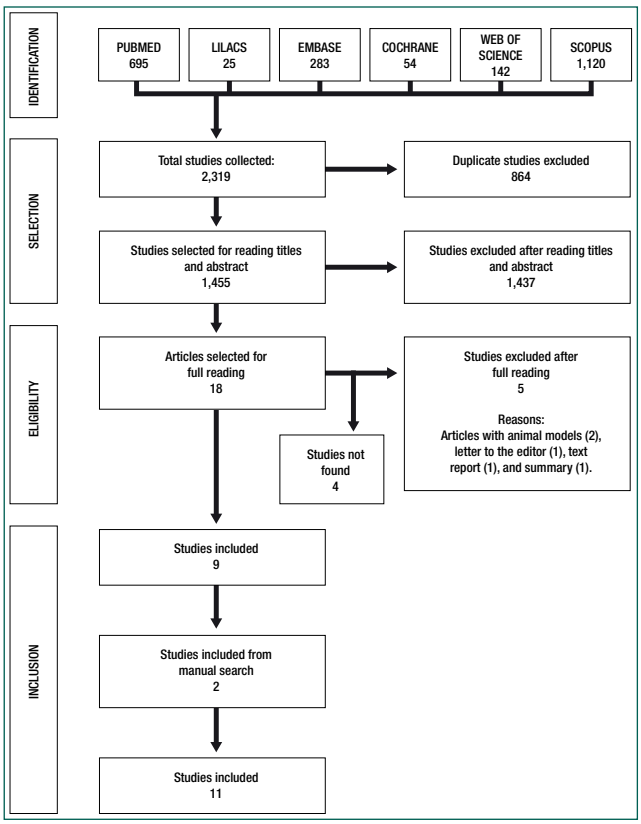
## Results

### Selection of studies

A total of 2319 bibliographic references were identified by electronic search in the six databases. Duplicate articles (864) were excluded with the help of the Endnote and Rayyan platforms. After reading titles and abstracts, 1437 articles were excluded. Eighteen studies were selected for full reading but four of them were not found. Nine studies were included in the database search. Two studies were included from the manual search, totaling 11 studies in the final sample. The study selection flowchart for this integrative review is presented in figure 1.

### Summary of results

A summary of the main results of the 11 studies included in this integrative review (total: 659 patients) is presented in chart 2.




Source: Material prepared by the authors (adapted from Page *et al.*, 2021).[21]

**Figure 1.** Study identification and selection flowchart

## Critical evaluation

The JBI tool (Critical Appraisal Checklist for randomized controlled trials) was used to evaluate randomized clinical trials (n=3). Of the 13 questions that comprise the checklist, a "yes" answer was received in two studies (9 answers)[22,25] and another study (6 answers).[23] When using the JBI tool (Critical Appraisal Checklist Quasi-experimental Studies; Non- Randomized Experimental Studies) to evaluate a study[24] of the quasi-experimental type included, seven questions received a "yes" answer among the nine questions in the checklist. To evaluate case series studies (n=2), the JBI tool (Critical Appraisal Checklist for Case Series) was used for ten checklist questions where one study[21] received nine "yes" responses and another study[27] received five "yes" responses. Finally, the JBI tool (Critical Appraisal Checklist for Case Series) was used to evaluate the case reports included in this IR (n=5) concerning seven questions of the tool where "yes" answers were received in four studies (7 answers)[29-32] and another study (3 responses)[27] (chart 3).

Of the 11 studies included, three were randomized clinical studies (27.3%), one non-randomized clinical study (9%), two observational studies (18.2%), and five case reports (45.5%) with levels of evidence II, III, VI, and VII, respectively.

According to the studies included, Urinary Retention occurred mainly in men, and the main cause was BPH.[22,26-32]

Participants' ages ranged from 52 to 82 years old, and the majority were over 64.4 years old. The volume of urine drained ranged from 1,000 to 7,000 ml. Studies have shown the presence of hematuria in volumes from 1,050 to 7,000 ml of drained urine. There was no relationship between drained volume and the presence of hematuria.[22-32]

When emptying the bladder, gradual and continuous decompressions until complete emptying were the most used techniques. The results of the studies state that there is no difference between the two techniques concerning outcome and prevention of hematuria. *I.e.*, gradual emptying of the bladder does not prevent hematuria compared to rapid and complete emptying of the bladder.[22-26,28]

On the other hand, five case reports presented important cases of hematuria requiring longer hospitalization of the patient after bladder decompression through urinary catheterization. Complications were such as hyponatremia, the need for additional treatment with intravenous infusion of volume replacement, and the need for blood transfusion (three cases).[27-32]

## Discussion

There is a centuries-old discussion about not emptying the bladder abruptly as a preventative care for hematuria in urinary catheterization. However, the practice and care to prevent hematuria have not yet been well defined.[14-17]

In the present review, it was possible to identify a higher frequency of hematuria after urinary catheterization in men (mean age: 64.4 years) undergoing treatment for BPH. After the urinary catheterization procedure, the main outcomes of hematuria occurred with prolonged hospital stay,

**Chart 2.** Summary of studies included in the integrative review that used bladder decompression techniques (urinary catheterization) to prevent hematuria in acute and chronic urinary retention in adults and elderly people

| Authors / Years / Countries | Objectives | Methodological designs | Main Results / Conclusions | Levels of evidence |
|---|---|---|---|---|
| Ahmed *et al.* 2013.[22] Nigeria | To determine the safety and effectiveness of the rapid and complete bladder decompression technique in chronic urinary retention. | Type: observational and prospective study. Sample: 22 male patients with chronic urinary retention. Mean Age: 53 years old. Techniques Used: Rapid decompression. | Hematuria occurred in 54.4% of cases. Benign Prostatic Hyperplasia was the primary cause of Urinary Retention in 45.5% of patients. Urinary catheterization was performed in 72.7% of patients; the others were not catheterized as they had suprapubic cystostomy. Mean volume drained: 1,500 ml. | VI |
| Boettcher *et al.* 2013.[23] Alemanha | Quantify and compare the risks of Rapid (RD) and Gradual (DG) Decompression bladder complications in patients with acute and chronic urinary retention. | Type: Prospective randomized clinical study. Sample: 294 male patients with acute and chronic urinary retention. Mean age: 72.5 years. Techniques used: Rapid and gradual decompression. | In the gradual and rapid decompression groups, hematuria occurred in 16 (11.3%) and 16 (10.5%) patients, respectively, with no statistically significant difference ($p$=1). In the gradual and rapid decompression groups, a drop in blood pressure (146/84 and 142/82 mmHg, respectively) was also observed after decompression. Mean volumes drained: 1,260.9MI and 1,089mL (gradual and rapid decompression, respectively). | II |
| Bristoll *et al.* 1989.[24] USA | To investigate how complete and clamped drainage affects blood pressure, pulse, and blood loss in catheterized patients with urinary retention. | Type: Randomized Clinical Study. Sample: Six patients with urinary retention. Age: not described in the study. Techniques Used: Rapid and gradual decompressions. | Blood traces were found in the urine sample of a patient in the rapid and complete decompression group. However, no result resulted in clinical complications. Drained Volume: 1,050-1,950 mL. | II |
| Christensen *et al.* 1987.[25] Denmark | Investigate changes in intravesical and arterial pressures during continuous or fractionated bladder drainage. | Type: Non-randomized clinical study. Sample: 10 male patients. Mean age: 74.5 years. Techniques Used: Rapid and gradual decompressions. Mean Drained Volume: 1,125 mL. | Only one patient presented mild and transient hematuria. Intravesical pressure fell by 50% of the initial value after eliminating 100 mL of urine. Blood pressure decreased after bladder decompression ($p \leq 0.05$). Mean Drained Volume: 1,125 mL. | III |
| Etafy *et al.* 2017.[26] USA | Compare rapid *versus* gradual bladder decompression in patients with acute RU to demonstrate benefits. | Type: Randomized Clinical Study. Sample: 62 patients with acute Urinary Retention diagnosed with Benign Prostatic Hyperplasia. Mean Ages: 64.4 and 63.2 years in the rapid and gradual decompression groups, respectively. Techniques Used: Rapid and gradual decompressions. | Hematuria occurred in the rapid decompression group (two patients) but not in the gradual decompression group; no significant difference ($p$=0.97). After rapid and gradual decompressions, drops occurred in mean arterial pressure (15 and 10 mmHg, respectively). Mean volumes drained: 1,119 and 1,074 mL in the rapid and gradual decompression groups, respectively. | II |
| Gabriel; Suchard, 2017.[27] USA | Describe the case of a patient with urinary retention and the presence of hematuria after urinary catheterization. | Type of Study: Case report. Sample: A male patient. Age: 52 years old. Techniques Used: Rapid decompression. | The patient developed macroscopic hematuria 3 h after the procedure. The authors concluded that severe hematuria may occur rarely although evidence exists that rapid decompression is safe. Drained Volume: 2,000 mL. | VII |
| Glahn; Plucnar 1984.[28] Denmark | Investigate the occurrence of hematuria. | Type: observational and prospective study. Sample: 260 patients; 215 (82.69%) men and 45 (17.3%) women. Mean age: 62 years old. Technique Used: Rapid decompression. | Hematuria occurred in 49 (16.3%) patients, with cases of mild (37; 75.5%), moderate (10; 20.4%), and severe (2; 4.1%) hematuria. In the second case, hematuria occurred for 24 h in a male patient; 2,000 mL of urine was drained; later, the patient was diagnosed with bladder stones and a clotting disorder. Drained Volume: <500 mL and >2,000 mL. | VI |
| Klamfoth; Burtson, 2022.[29] USA | Present the case and highlight the severity of post-obstructive diuresis and decompressive hematuria in the scenario of chronic urinary retention secondary to Benign Prostatic Hyperplasia. | Type of Study: Case Report Sample: Male patient Age: 73 years old Technique Used: Rapid decompression. | One hour after catheterization, the patient presented significant hematuria, post-obstructive diuresis, and hypotension. He received a blood transfusion, bladder irrigation, instillation of antifibrinolytics, and electrolyte replacement. Drained Volume: 5,900 mL. | VII |
| Knapp; Apgar; Pennell 2022.[30] USA | Explore the potentially fatal complications of urinary retention and bladder decompression. | Type of Study: Case Report. Sample: Male patient. Age: 57 years old. Technique Used: Gradual decompression. | The catheter was clamped with 1,000 mL of drained urine. The catheter was unclamped after urology guidance. The patient presented hematuria, and the hemoglobin level dropped from 10.1 to 5.7 ml/dl. The patient received a red blood cell concentrate and intravenous volume infusion and underwent bladder irrigation and surgical intervention (cystoscopy, bladder biopsy, and clot removal). Drained volume: <7,000 mL. | VII |
| Naranji; Bolgeri, 2012.[31] UK | To describe a case of hematuria in the upper urinary tract after urinary catheterization. | Type of Study: Case report. Sample: Male patient. Age: 82 years old Technique Used: Rapid decompression | In the first 48 h after the procedure, the patient presented significant hematuria with a drop in hemoglobin to 7.8 g/dl, requiring bladder irrigation and blood transfusion. Laboratory and imaging tests were carried out showing an enlarged prostate. No stone or malignancy was identified. Drained volume: 2,900 mL. | VII |
| Nayak *et al.,* 2013.[32] India | Describe the case of a patient who presented hematuria after bladder decompression. | Type of Study: Case report. Sample: Male patient. Age: 67 years old. Technique Used: Rapid decompression. | The imaging examination showed an enlarged prostate and bilateral dilation of the kidney. The patient presented severe hematuria followed by hyponatremia. The hematuria followed for more than a week. The patient underwent a nephrostomy. Clots were found in the right ureter. No tumor was identified. Drained Volume: 4,000 ml. | VII |

**Chart 3.** Methodological evaluation of primary studies using the JBI Critical tool Appraisal checklist tool for quasi-experimental randomized clinical trials, case series, and case reports

| Types of studies | Studies | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Total (yes) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Randomized clinical trials | Etafy *et al.*, 2017.[26] | Y | N* | Y | N** | N | N* | Y | Y | Y | Y | Y | Y | Y | 9/13 |
| | Boettcher *et al.*,2013.[23] | Y | Y | Y | N** | N | N* | N | Y | Y | Y | Y | Y | Y | 9/13 |
| | Bristoll *et al.*,1989.[24] | N* | N* | Y | N** | N | N* | Y | N | Y | Y | Y | Y | N | 6/13 |
| Quasi-experimental | Christensen *et al.*1987.[24] | Y | Y | Y | Y | N | Y | N | Y | Y | | | | | 7/9 |
| Case series | Ahmed *et al.*, 2013.[22] | Y | Y | Y | Y | Y | Y | Y | Y | Y | N | | | | 9/10 |
| | Glahn; Plucnar.1984.[28] | Y | Y | N | Y | N | N | Y | Y | N | N* | | | | 5/10 |
| | Klamfoth; Burtson, 2022.[29] | Y | Y | Y | Y | Y | Y | Y | | | | | | | 7/7 |
| | Knapp; Apgar; Pennell, 2022.[30] | Y | Y | Y | Y | Y | Y | Y | | | | | | | 7/7 |
| | Naranji; Bolgeri, 2012.[31] | Y | Y | Y | Y | Y | Y | Y | | | | | | | 7/7 |
| | Nayak et al, 2013.[32] | Y | Y | Y | Y | Y | Y | Y | | | | | | | 7/7 |
| | Gabriel; Suchard, 2017.[27] | Y | N | N | Y | N | N | Y | | | | | | | 3/7 |

Randomized clinical trials – Q1: Was the randomization reliable?; Q2: Was the division of groups carried out blindly?; Q3: Were the groups similar at baseline?; Q4: Were participants "blind" to treatment assignment?; Q5: Were those who underwent treatment blind to the assigned group?; Q6: Were the evaluators blind to the evaluation?; Q7: Were the groups treated identically, except for the intervention of interest?; Q8: If follow-up was not complete, were differences between groups adequately described and analyzed in terms of follow-up?; Q9: Were the participants analyzed in groups?; Q10: Were results measured in the same way across treatment groups?; Q11: Were the results measured reliably?; Q12: Statistical analysis was appropriate; Q13: Was the study design appropriate and were possible deviations from the standard design considered? Quasi-experimental – Q1: Is it clear what the causes and effects are?; Q2: Were the participants included in comparisons similar?; Q3: Did the participants included in the comparison receive similar treatments?; Q4: Was there a control group?; Q5: Were there multiple result measurements before and after the intervention?; Q6: If follow-up was not complete, were differences between groups adequately described and analyzed in terms of follow-up?; Q7: Were the results included in the comparison measured in the same way?; Q8: Were the results measured reliably?; Q9: Was statistical analysis appropriate? Case series – Q1: Were there clear criteria for inclusion?; Q2:Was the condition measured in a standardized and reliable way?; Q3: Were valid methods used to identify the condition in all participants?; Q4: Was there consecutive inclusion of participants?; Q5: Was there complete inclusion of participants?; Q6: Was there clear reporting on participant demographics?; Q7: There was clear reporting of clinical information; Q8: Were case follow-up results clearly reported?; Q9:Was reporting of demographic information consistent?; Q10: Was the statistical analysis appropriate? Case reports – Q1: Were demographic characteristics clearly described?; Q2: Was the patient's history clearly described and presented as a timeline?; Q3: Has the current clinical condition been clearly described?; Q4: Were the treatment intervention(s) clearly described?; Q5: Was the post-intervention clinical picture clearly described?; Q6: Have adverse events been identified and described?; Q7: Does the case provide take-home lessons?; Y: yes; N: no; n*:not clear; n**: not applicable

hyponatremia, need for volume replacement, and blood transfusion. However, verifying the evidence on the safest urinary catheterization technique to prevent hematuria was not possible.

Establishing factors such as populations at greatest risk in specific clinical situations and recognizing the main outcomes and therapeutics employed are fundamental elements to be included in care protocols in teaching and daily nursing practice.

We consider that hematuria may occur after bladder decompression 1-2 h after urethral catheterization. The event is caused by hyperemia in the bladder mucosa due to dilation or even rupture of large veins. This, combined with the drop in intravesical pressure, leads to bleeding.[14]

In an experimental study on 16 patients with Urinary Retention, Osius and Hinman (1963),[33] observed that a 50% drop occurs in intravesical pressure for every 100 ml of urine drained regardless of the residual volume. Such results were also found in the study by Christensen *et al.* (1987).[25] This reinforces that slow decompression to avoid hematuria is complex. In clinical practice, it becomes a time-consuming intervention as it is not standardized, thus increasing the risk of urinary infection related to the complete and slow emptying of the bladder.[33,34]

The studies in this review also found no association between the volume of urine in the bladder and the occurrence of hematuria. Furthermore, no significant difference was found between the two most cited techniques to prevent hematuria as pointed out in the scientific literature.[15,17]

The conditions and complications associated with bladder decompression by gradual or rapid catheterization must be considered in the nursing care plan. The case reports included in this review showed important situations of hematuria requiring volume replacement and blood transfusion.[27,31,32]

The case report by Naranji and Bolgeri (2012) also cites a condition related to significant hematuria. An 82-year-old man who underwent bladder catheterization (with drainage of 2,900 ml of urine), presented hematuria for 48 h after the procedure (with serum hemoglobin of 7.8 mg/dl). Furthermore, his exams showed increased C-reactive protein (CRP; 188 mg/dl), leukocytosis (20,000/mm$^3$), occlusive prostate, and bladder with diverticula. His history showed the use of acetylsalicylic acid for ischemic disease, which increased the risk of bleeding.[31]

In these patients with Urinary Retention, anticoagulation is a therapy to be evaluated before urinary catheterization. A retrospective cohort study carried out using data from the patient's medical records looked for the occurrence of bleeding events related to invasive devices in anticoagulated patients. From 2011 to 2012, 867 medical records were analyzed. Patients over 18 years of age, with a hospital stay of ≥2 days, who received continuous infusion of sodium heparin were the inclusion criteria. The study found that the risk of bleeding in the genitourinary system is 15% in anticoagulated patients. Anticoagulated patients using an indwelling bladder catheter are seven times more likely to experience hematuria compared to those who did not use the device.[34,35]

Another important aspect to be highlighted in this review was as follows: in seven of the studies included, patients presented hypotension as a complication after bladder decompression, but without other clinical complications. Cases of hypotension were associated with obstructive diuresis (after draining over 2000 ml of urine), requiring volume replacement.[22-26,29,30]

Loss of diuresis is physiological and occurs so that solutes and liquids that were accumulated in Urinary Retention are eliminated. Post-obstructive diuresis occurs after the bladder is emptied and characterizes a condition of prolonged polyuria in which hyponatremia occurs due to loss of water and excessive loss of sodium. Therefore, electrolyte disturbance, dehydration, hypotension, and even hypovolemic shock are the complications of post-obstructive diuresis. This occurs when a volume >1500 ml of urine is drained.[2]

The results also showed the prevalence of Urinary Retention among men, the main cause being BPH. It is considered the most prevalent comorbidity in aging. Given population growth and an increase in the elderly population, Urinary Retention is then a common condition in emergency care units.[4]

We emphasize that the cause of Urinary Retention also includes some types of damage to peripheral nerves caused by neuropathy related to diabetes *mellitus*, *e.g.*, or urinary retention in young patients caused by infection or medication use.[4]

Nurses are the pioneering professionals in diagnosing urinary retention.[4] Given the synthesis of this review, we understand that Urinary Retention and urinary catheterization involve possible complications or risks to patients, such as hypotension and hematuria, whether through gradual or rapid decompression of the bladder (often requiring therapy with intravenous volume replacement and/or blood transfusion). Such complications must be addressed and updated in the training and continuing education of nurses.

Given such complications associated with urinary catheterization (a procedure exclusive to nurses), we emphasize that carrying out a broad and complete assessment of patients is important. In the case of Urinary Retention, investigating imaging tests, seeking history of previous surgery, knowing medications for continuous use, as well as investigating previous urinary catheterization should be part of nurses' data collection. This is necessary to be able to offer individualized and good quality care, listing possible risks related to the procedural intervention.

Preventing Urinary Retention can be understood as the key element in avoiding such complications, thus avoiding the need to perform urinary catheterization, as studies indicate that the damage begins with progressive distension of the bladder wall.[14]

We emphasize that the majority of cases in this review were patients who arrived at the emergency department with signs and symptoms of Urinary Retention, as the scientific literature already pointed out.[14] Therefore, health education for self-care at home, informing patients about ideal or expected urinary elimination, possible risks of urinary tract infection, urinary retention, and urinary catheterization should be part of nurses' care plan for the at-risk population.

This integrative review highlighted the need for scientific advancement in the area of nursing on urinary catheterization, an intervention exclusive to nurses (and carried out daily in health institutions). Furthermore, it highlighted the lack of standardization of the procedural technique, which directly impacts the quality of care and patient safety. In this

review, the importance of nursing in the identification and prevention of Urinary Retention to avoid subsequent clinical interventions and complications (including post-urinary catheterization hematuria) also stands out.

The limitations of this review were as follows: four studies were not found and the number of randomized clinical studies was reduced, considered level II evidence for intervention questions within the theme of urinary catheterization and hematuria outcome.

## Conclusion

Two techniques are used to empty the bladder: rapid and gradual decompression, but none of them ensure the prevention of hematuria. Nursing is important in the identification and prevention of Urinary Retention to avoid possible complications. More robust studies are needed in the basic and clinical areas to elucidate aspects related to the causes, pathophysiology, and manifestation of hematuria in adults and elderly people after bladder decompression by urinary catheterization.

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## References

1. D'Ancona C, Haylen B, Oelke M, Abranches-Monteiro L, Arnold E, Goldman H, Hamid R, Homma Y, Marcelissen T, Rademakers K, Schizas A, Singla A, Soto I, Tse V, de Wachter S, Herschorn S; Standardisation Steering Committee ICS and the ICS Working Group on Terminology for Male Lower Urinary Tract & Pelvic Floor Symptoms and Dysfunction. The International Continence Society (ICS) report on the terminology for adult male lower urinary tract and pelvic floor symptoms and dysfunction. Neurourol Urodyn. 2019;38(2):433-77.
2. Leslie SW, Sajjad H, Sharma S. Postobstructive Diuresis. In: StatPearls. Treasure Island (FL): StatPearls; 2022 [cited 2022 June 5]. Available from: https://www.statpearls.com/point-of-care/38132
3. Freitas EV, Py L. Tratado de Geriatria e Gerontologia. 5ª ed. Rio de Janeiro: Guanabara Koogan; 2022. pp. 1221-222.
4. Billet M, Windsor TA. Urinary Retention. Emerg Med Clin North Am. 2019;37(4):649-60. Review.
5. Sliwinski A, D'Arcy FT, Sultana R, Lawrentschuk N. Acute urinary retention and the difficult catheterization: current emergency management. Eur J Emerg Med. 2016;23(2):80-8. Review.
6. Potter P, Perry AG, Stockert P. Fundamentos de Enfermagem. 9ª ed. Rio de Janeiro: Elsevier; 2018. pp. 420-37.
7. Guyton AC, Hall JE. Tratado de Fisiologia Médica. 13ª ed. Elsevier; 2017.
8. Cabreira V, Massano, J. Doença de Parkinson: revisão clínica e atualização. Acta Med Port. 2010;32(10):661-70. Review.
9. Mota EC, Oliveira AC. Catheter-associated urinary tract infection: why do not we control this adverse event? Rev Esc Enferm USP. 2022;53:e034522019.
10. Brasil. Conselho Federal de Enfermagem (COFEN). Resolução n. 450 de 2013. Parecer normativo para atuação da equipe de enfermagem em sondagem vesical, Brasília (DF): COFEN; 2013 [citado 2022 Jan 5]. Disponível em: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://www.cofen.gov.br/wp-content/uploads/2013/12/RESOLUCAO-450-2013.pdf
11. Anjos MK, Azevedo TG, D`Eça Junior A, Silva RA, Stipp MA, Paes GO. Incidents associated with delayed bladder catheterization in hospitalized patients: an integrative review. Res Soc Devel. 2020;9(8):e41985115.
12. Ingelfinger JR. Hematuria in adults. N Engl J Med. 2021;2(385):153-63.
13. McDougal WS, Wein AJ, Kavoussi LR, Partin AW, Peters CA. Campbell-Walsh urologia perguntas e respostas. 11ª ed. São Paulo: Elsevier. 2018. 624 p.
14. Muhammed A, Abubakar A. Fisiopatologia e manejo da retenção urinária em homens. Arcos Int Cirurg. 2012;2(1):63-9.
15. Nyman MA, Schwenk NM, Silverstein MD. Management of urinary retention: rapid versus gradual decompression and risk of complications. Mayo Clin Proc. 1997;72(10):951-6. Review.
16. Creevy CD. Sudden decompression of the chronically distended urinary bladder: a clinical and pathologic study. Arch Surg. 1932;25:356–85.
17. Wu MY, Chang JR, Lee YK, Lin PC, Tsai TY. The effect and safety of rapid and gradual urinary decompression in urine retention: a systematic review and meta-analysis. Medicina (Kaunas). 2022;58(10):1441. Review.
18. Mendes KD, Silveira RC, Galvão CM. Revisão integrativa: método de pesquisa para a incorporação de evidências na saúde e na enfermagem. Texto Contexto Enferm. 2008;17(4):758–64. Review.
19. Aromataris E, Munn Z, editors. JBI Manual for Evidence Synthesis. Adelaide: Joanna Briggs Institute; 2020 [cited 2022 Jan 5]. Available from: https://jbi-global-wiki.refined.site/space/MANUAL
20. Melnyk BM, Fineout-Overholt E. Evidence-based practice in nursing & healthcare. A guide to best practice. 4ªed. Philadelphia: Lippincott Williams & Wilkins; 2019. 868 p.
21. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021;372:n71.
22. Ahmed M, Abubakar A, Lawal AT, Bello A, Maitama HY, Mbibu HN. Rapid and complete decompression of chronic urinary retention: a safe and effective practice. Trop Doct. 2013;43(1):13-6.
23. Boettcher S, Brandt AS, Roth S, Mathers MJ, Lazica DA. Urinary retention: benefit of gradual bladder decompression - myth or truth? A randomized controlled trial. Urol Int. 2013;91(2):140-4.

24. Bristoll SL, Fadden T, Fehring RJ, Rohde L, Smith PK, Wohlitz BA. The mythical danger of rapid urinary drainage. Am J Nurs. 1989;89(3):344-5.

25. Christensen J, Ostri P, Frimodt-Møller C, Juul C. Intravesical pressure changes during bladder drainage in patients with acute urinary retention. Urol Int. 1987;42(3):181-4.

26. Etafy MH, Saleh FH, Ortiz-Vanderdys C, Hamada A, Refaat AM, Aal MA, et al. Rapid versus gradual bladder decompression in acute urinary retention. Urol Ann. 2017;9(4):339-42.

27. Gabriel C, Suchard JR. Hematuria following rapid bladder decompression. Clin Pract Cases Emerg Med. 2017;1(4):443-45.

28. Glahn BE, Plucnar BJ. Quick complete emptying of the bladder in 300 cases of urinary retention. The occurrence of haematuria. Dan Med Bull. 1984;31(1):68-70.

29. Klamfoth JK, Burtson KM. Severe urinary retention resulting in extreme post-obstructive diuresis and decompressive hematuria. Cureus. 2022;14(9):e29626.

30. Knapp BJ, Apgar L, Pennell K. Life-threatening complications associated with bladder decompression: a case report. Clin Pract Cases Emerg Med. 2022;6(4):298-301.

31. Naranji I, Bolgeri M. Significant upper urinary tract hematuria as a rare complication of high-pressure chronic retention of urine following decompression: a case report. J Med Case Rep. 2012;6:254.

32. Nayak B, Abrol N, Singh P, Kumar R. Bladder decompression for chronic urinary retention may lead to upper tract bleeding. Natl Med J India. 2013;26(2):82-3.

33. Osius TG, Hinman F. Dynamics of acute urinary retention: a monometric, radiographic and clinical study. J Urol. 1963;90(6):702-12.

34. Dodds P, Hans AL. Distended urinary bladder drainage practices among hospital nurses. Appl Nurs Res. 1990;3(2):68-9.

35. Camerini FG, Silva LD, Henrique DM, Andrade KB, Almeida LF. Ocorrência de eventos hemorrágicos relacionados aos dispositivos invasivos manipulados pela enfermagem em pacientes anticoagulados. Rev Rede Enfermagem Nordeste. 2017;18(4):437-44.