Postobstructive diuresis

Pay close attention to urinary retention

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Abstract

Objective To educate primary health care professionals about the diagnosis and treatment of postobstructive diuresis (POD), a rare but potentially lethal complication associated with the relief of urinary obstructions.

Sources of information The main concepts and clinical evidence reviewed in this article were derived from a literature search of PubMed and Google Scholar. Expert opinion was used to supplement recommendations in areas with little evidence.

Main message Urinary retention is a frequently encountered presentation seen by all physicians. Most family physicians are comfortable treating these patients, initiating investigations, and organizing appropriate follow-up. This article reviews a rare but potentially lethal complication known as POD. Postobstructive diuresis is a polyuric response initiated by the kidneys after the relief of a substantial bladder outlet obstruction. In severe cases this condition can become pathologic, resulting in dehydration, electrolyte imbalances, and death if not adequately treated. Primary care physicians should be familiar with this potential clinical entity, especially as they are generally the first to encounter and treat these patients.

Conclusion Physicians aware of POD will be able to identify patients at risk and arrange the appropriate monitoring after relieving a urinary obstruction. Early diagnosis and treatment of pathologic POD will prevent mortality.

Diurèse postocclusive

Apporter une attention particulière dans les cas de rétention urinaire

Résumé

Objectif Renseigner les professionnels des soins primaires concernant le diagnostic et le traitement du syndrome de levée d’obstacle (SLO), une complication rare mais potentiellement mortelle associée au soulagement des obstructions urinaires.

Sources des données Les principaux concepts et données scientifiques cliniques du présent article sont tirés d’une recherche documentaire dans PubMed et Google Scholar. Les opinions d’experts viennent compléter les recommandations dans les domaines où les données probantes se font rares.
Message principal  Tous les médecins voient couramment des cas de rétention urinaire. La plupart des médecins de famille se sentent à l’aise de traiter de tels patients, amorcent des investigations et organisent le suivi qui s'impose. Cet article présente une complication rare mais possiblement mortelle connue sous le nom de SLO. Le SLO, ou diurèse postocclusive, est une réaction polyurique déclenchée par les reins après le soulagement d’une obstruction importante du col de la vessie. Dans les cas graves, ce problème peut devenir pathologique, entraînant une déshydratation, un déséquilibre hydroélectrolytique et la mort, s’il n’est pas traité adéquatement. Les médecins de soins primaires devraient être familiers avec ce problème clinique potentiel, surtout qu’ils sont généralement les premiers à voir et traiter de tels patients.

Conclusion  Les médecins qui connaissent le SLO seront en mesure de dépister les patients à risque et d’assurer une surveillance appropriée après avoir soulagé l’obstruction urinaire. Un diagnostic et un traitement sans délai d’un SLO pathologique préviendront la mortalité.

Case description  

An 87-year-old man was urgently recalled to his family medicine clinic after his physician received an ultrasonic report revealing a postvoid residual volume estimated at 3790 mL, bilateral severe hydronephrosis, a marked distended bladder, and 2 suspicious 2.5-cm solid growths arising from the bladder wall (Figure 1). The investigation had been ordered 6 days previously after identifying a progressive rise in the patient’s serum creatinine level. The patient’s serum creatinine levels during the previous 3 months were as follows: 141 µmol/L, 165 µmol/L, 180 µmol/L, and 203 µmol/L. On average, his baseline creatinine levels were between 130 and 150 µmol/L and his serum glucose and electrolyte levels were consistently within normal limits. His past medical history included chronic kidney disease, type 2 diabetes, hypertension, congestive heart failure, osteoarthritis, and benign prostatic hyperplasia. His relevant past surgical history included a transurethral resection of the prostate 2½ years previously. He denies any symptoms other than passing only 250 mL of urine during the previous 48 hours. On examination, his abdomen was distended, with the top of the bladder palpable midway between the umbilicus and the xiphoid process. Further, an examination of his external genitalia revealed a substantial phimosis to the distal 1 cm of the foreskin.

Sources of information  
The literature review was conducted using PubMed and Google Scholar and the key words urinary retention, urinary obstruction, bladder outlet obstruction, and post obstructive diuresis. All relevant articles providing information and evidence on urinary retention and post-obstructive diuresis (POD) epidemiology, risk factors, diagnosis, and management were considered for inclusion. Recommendations were graded based on their level of evidence in accordance with the Canadian Task Force on Preventive Health Care. Level I evidence originated from properly conducted randomized controlled trials, systematic reviews, or meta-analyses. Level II evidence originated from other non-randomized comparison trials, and level III evidence is based on expert opinion or consensus statements.

Main message  

Urinary retention.  Urinary retention is a common clinical condition addressed in both primary health care clinics and hospitals. It is traditionally classified as acute or chronic. Acute urinary retention (AUR) is a rapid-onset condition associated with suprapubic pain and the inability to urinate. Conversely, chronic urinary retention (CUR) has a gradual onset, with no associated pain and the ability to pass only small amounts of urine. These patients might also present with overflow urinary incontinence. Chronic urinary retention is further classified into high- and low-pressure CUR. The presence or absence of intrinsic detrusor pressure is what differentiates them. High-pressure CUR results from an obstruction with the presence of detrusor muscle activity, while low-pressure CUR involves detrusor failure with low intravesical pressure. This distinction is important, as high detrusor pressure can lead to upper urinary tract damage and present with new-onset hypertension, peripheral edema, or renal dysfunction.

The incidence of urinary retention is higher in men than in women and increases with age. It is estimated that 1 in 10 men between the ages of 70 and 79 and 3 in 10 men between the ages of 80 and 89 will have an episode of AUR within their lifespans. Apart from age and sex, other risk factors associated with an increased risk of urinary retention include lower urinary tract symptoms, prostate disease, long-standing diabetes, recurrent catheterization, fecal impaction, and the use of anticholinergic medications.

After a thorough history taking and physical examination, the patient should be assessed for a palpable bladder and neurologic integrity, and a rectal examination should be performed to assess the prostate and rectal tone. Urinary retention can be confirmed with a postvoid bladder ultrasound or the placement of a urinary catheter demonstrating a large residual urine volume. There are currently no universally accepted diagnostic values for a normal postvoid residual volume, but it has been reported that AUR is associated...
with a residual urine volume of 500 to 600 mL, whereas CUR is associated with a volume of greater than 800 mL. Commonly, patients with CUR present with 1.0 L to 1.5 L of retained urine, with some case reports noting volumes greater than 4 L.

Bladder outlet obstruction (BOO). Bladder outlet obstruction is the most common cause of urinary retention and a list of causes is outlined in Box 1. In many cases this obstructive process is gradual and can evolve into CUR. As the BOO progresses, the detrusor pressure will also increase, resulting in high-pressure CUR. In severe cases, BOO can lead to vesicoureteral reflux and subsequent hydronephrosis. Prolonged high-pressure hydronephrosis can injure nephrons and result in renal dysfunction.

Postobstructive diuresis. Postobstructive diuresis is a polyuric state in which copious amounts of salt and water are eliminated after the relief of a urinary tract obstruction. The incidence of POD is unclear but estimates suggest 0.5% to 52% of patients will experience POD after relief of obstruction. It generally occurs after relieving BOO, bilateral ureteric obstruction, or unilateral ureteric obstruction in a solitary kidney. Diuresis is a normal physiologic response to help eliminate excess volume and solutes accumulated during the prolonged obstruction. In most patients, the diuresis will resolve once the kidneys normalize the volume and solute status and homeostasis is achieved. Some patients will continue to eliminate salt and water even after homeostasis has been reached, referred to as pathologic POD. These patients are at risk of severe dehydration, electrolyte imbalances, hypovolemic shock, and even death if fluid and electrolyte replacement is not initiated.

Numerous mechanisms have been proposed to describe the pathophysiology of POD, which include a progressive reduction in the medullary concentration gradient secondary to vascular washout and down-regulation of sodium transporters in the thick ascending loop of Henle; reduction in glomerular filtration rate, which leads to ischemia and loss of juxtamedullary nephrons; and reduced response of the collecting duct to circulating antidiuretic hormone, leading to nephrogenic diabetes insipidus. The most likely cause is a combination of all these mechanisms.

Figure 1. Renal ultrasound of bladder outlet obstruction

Left hydronephrosis
Right hydronephrosis
Bladder masses
Distended postvoid bladder
It is difficult to predict which patients will develop POD after the release of urinary tract obstruction. A recent article by Hamdi et al identified the initial presence of a high serum creatinine level, a high sodium bicarbonate level, and urinary retention as independent risk factors for developing POD after decompressing an obstructed urinary tract. Further, there are very few clinical markers that help predict which individuals with physiologic POD will progress to pathologic POD. There is no correlation between initial creatinine values, urea values, electrolyte values, creatinine clearance, or presence of hypertension with the severity of diuresis. However, some studies have found that the presence of renal insufficiency, heart failure or evidence of volume overload, dizziness, and central nervous system depression are risk factors for developing substantial POD.

Postobstructive diuresis is a clinical diagnosis based on urine output after decompressing an obstructed bladder or ureter. Urine production exceeding 200 mL per hour for 2 consecutive hours or producing greater than 3 L of urine in 24 hours is diagnostic of POD (level III evidence). Physiologic POD is self-limiting and generally lasts 24 hours. Pathologic POD generally lasts longer than 48 hours and can be exacerbated with excessive intravenous fluid replacement. The treatment of urinary retention begins with immediate catheter placement to decompress the bladder. It was once thought that decompression of the bladder should be performed gradually with periodic clamping to prevent hematuria, hypotension, and POD. However, a recent review by Nyman et al revealed that there is no evidence linking these complications with quick, complete bladder emptying, and the authors conclude that this is a safe and effective method of bladder decompression (level I evidence).

Patients with decompressed urinary obstruction (BOO, bilateral ureteric obstruction, or unilateral ureteric obstruction of a solitary kidney) need to be monitored closely for POD and might have to be admitted for a 24-hour observation period. These individuals should have their urine output recorded every 2 hours and vital signs checked every 6 to 8 hours. Further, their serum electrolyte (especially potassium), magnesium, phosphate, urea, and creatinine levels should be checked every 12 to 24 hours and corrected if necessary. These patients should be allowed free access to oral hydration and can be discharged after 24 hours if POD is not confirmed. A follow-up visit with a urologist should be arranged for a later date for further management of their obstructive uropathy.

If the patient’s urine output exceeds 200 mL per hour for 2 consecutive hours, or is greater than 3 L over 24 hours, then this is diagnostic of physiologic POD and requires closer monitoring for conversion to pathologic POD. These individuals should continue to have their urine outputs recorded, should be weighed daily, and should have their serum electrolyte, magnesium, phosphate, urea, and creatinine levels monitored every 12 hours or more frequently as necessary (level III evidence). A urine sample should be collected for urinary sodium and potassium levels and urine osmolality to determine if it is a salt or urea type of diuresis. Urea diuresis is generally self-limiting, whereas salt diuresis can convert to pathologic POD and requires careful monitoring of serum electrolyte levels and hydration status. Spot urine sodium levels greater than 40 mEq/L suggest renal tubular injury and if prolonged can lead to pathologic POD.

A simple method to estimate urine osmolality, if an automated method is not available, is to assess the urine specific gravity. A specific gravity of 1.010 is iso-osmotic with serum osmolality, indicating that the kidneys do not need to concentrate the urine. This is consistent with physiologic POD and is generally self-limiting. A specific gravity of 1.020 demonstrates that the kidneys are concentrating the urine and POD has resolved or has nearly resolved. However, a specific

### Box 1. Causes of bladder outlet obstruction

The following are causes of bladder outlet obstruction:
- Genitalia: Meatal stenosis, phimosis, paraphimosis, atrophic vaginitis
- Urethra: Stones, strictures, diverticulum, posterior urethral valves, carcinoma, surgery
- Prostate: Benign prostatic hyperplasia, calculi, abscess, prostate carcinoma
- Gynecologic: Prolapse, cystocele, pregnancy, ovarian mass, uterine tumour, cervical tumour
- Bladder: Calculi, blood clot, tumour, bladder neck dysfunction
- Bowel: Fecal impaction
- Neurogenic: Multiple sclerosis, diabetes, spinal cord trauma, Parkinson disease, cerebrovascular accident

Data from Klahr.

### Box 2. Complications of urinary catheters

The following are complications associated with urinary catheters:
- Urethral trauma
- Urinary tract infection
- Retained balloon fragments
- Bladder stone formation
- Bladder fistula
- Bladder perforation

Data from Schaeffer.
Gravity of 1.00 is hypo-osmotic with serum osmolality, indicating the kidneys’ inability to concentrate the urine. This is consistent with pathologic salt-wasting POD and should alert the health care team to monitor the patient closely (level III evidence). Fluid balance should be closely monitored and a negative balance should be targeted in these patients. It is recommended to replace 75% of the previous 1-hour urinary output (level III evidence). Excessive fluid should be avoided as it can prolong or exacerbate the diuresis. Individuals without cognitive impairment should continue to take hydration orally. However, cognitively impaired patients should receive 0.45% normal saline intravenously. In physiologic POD, when the patient reaches a euvoelemic state, the diuresis should resolve and this will be evident by a 24-hour urine production of less than 3 L.

If pathologic POD ensues, then polyuria will continue even after a euvoelemic state has been reached. These patients are at risk of hypovolemia and can become hemodynamically unstable. Prolonged polyuria also places the patient at risk of electrolyte and acid-base disturbances (Box 3). Patients with pathologic POD require strict monitoring of vital signs, fluid status, and serum electrolyte levels, and benefit from the involvement of a nephrologist. Regardless of cognitive function, all patients with pathologic POD require intravenous fluid replacement run at a negative balance. The type and amount of fluid should be tailored to the patient’s needs based on his or her serum and urinary electrolyte levels and clinical hydration status.

Case resolution

An abdominal examination and ultrasound imaging confirmed BOO, complicated by a phimosis. With the aid of an assistant and 2.5% lidocaine cream, the foreskin was successfully retracted and a no. 16 French gauge urinary catheter was inserted. The patient drained 5500 mL of urine over 90 minutes. Arrangements were made to admit the patient to the local hospital under the care of family medicine to further monitor urine output, hydration status, and serum electrolyte levels. On admission, his serum electrolyte and glucose levels were normal, with serum creatinine and urea levels elevated to 190 µmol/L and 14.7 mmol/L, respectively. The patient’s course in hospital was unremarkable, his urine output remained below 200 mL per hour, and his serum electrolyte levels remained within normal limits. Although this patient was at risk of developing POD, he fortunately did not. The patient was discharged 24 hours later with a catheter in situ. A cystoscopy appointment was arranged to investigate his bladder masses and revealed regrowth of residual prostatic tissue at the base of his bladder.

Box 3. Complications of postobstructive diuresis

The following are complications of pathologic postobstructive diuresis:

- Volume depletion
- Hyponatremia or hypernatremia
- Hypokalemia
- Hypomagnesemia
- Metabolic acidosis
- Shock
- Death

Data from Baum et al10 and Gonzales.14

Conclusion

Urinary retention is a common clinical condition encountered by all physicians at some point in their careers. As described above, the initial medical approach involves decompressing the bladder with the placement of a urethral catheter, followed by a workup to identify the underlying cause. However, how often do primary care physicians consider the potential effects of rapidly draining a patient’s bladder on the rest of the body? One might argue there is little effect, as doing so mimics urination, the normal physiologic process that has been perfected over thousands of years of natural selection. However, in some situations, acute drainage of an obstructed urinary tract can unmask deranged renal mechanisms and result in uncontrolled, unregulated urine production known as postobstructive diuresis. Postobstructive diuresis is important because it can occur in up to 50% of patients with substantial urinary tract obstruction and can be life-threatening if it becomes pathologic and is not adequately treated. The goal of this article is to make primary care physicians aware of this clinical entity and help them confidently identify individuals at risk, initiate appropriate monitoring to allow for early diagnosis, and provide adequate treatment to avoid any adverse outcomes.

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Contributors

Drs Halbgewachs and Domes contributed to the literature review and interpretation, and to preparing the manuscript for submission.

Competing interests

None declared

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