Management of Hematuria
All You Always Wanted to Know

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ABSTRACT
Hematuria is a frequent condition with important health and economic consequences. There is a need for nurses and urologists to improve their assessment acknowledgments and skills about this multifaced entity. The aim of this paper is to review all current knowledge about the best way to manage this important problem including a prioritized list of steps taken to stop or diminish bleeding, to assess whether a catheter is blocked, to solve all related problems and maintain catheter patency for continuous bladder irrigation.
There is a lack of written information and basic formation training about the steps that should be done in case of hematuria and, notoriously, the best way to perform a bladder washout in an effective way.

Keywords: hematuria, urethral catheter, blood clots, vesical washout

1. INTRODUCTION
Hematuria, defined as a clearly visible change in urine color due to the presence of blood in it, could be a symptom of serious urinary tract disease and cause serious complications to the patient if it is not treated quickly.
In the past, severe hematuria was seen mainly after open prostatectomy, transurethral resection of the prostate (TURP) and endoscopic resection of a bladder tumor (TURB). However, in the present time, some important factors as the aging of the population, the common use of anticoagulant/antiplatelet drugs, frequent radiotherapy treatments and the increase of recurrent urinary tract infections make the gross hematuria one of the most frequent reasons for urgent hospitalization in urologic services. The growing number of iatrogenic, spontaneous and post-surgical gross hematuria requires verification of guidelines for the management of all these patients.
Gross hematuria occurred in 2.5% of the population and is claimed to involve 4% of all urological visits. Moreover, in a review of observational studies, average annual rates of fatal, and major and all severity bleeding was 0.8%, 4.9% and 15% respectively (Antoniewicz A. et al, 2012). In economic terms, gross hematuria causes spending of millions of dollars worldwide and better management protocols may help reducing costs and patient complications.
In this context, there is a need for nurses and urologists to improve their assessment acknowledgments and skills in clinical procedures related to gross hematuria with special attention to stop bleeding, solve related problems and maintain catheter patency.

2. DISCUSSION

The aim of this paper is to review all current knowledge about the best way to manage this important problem including a prioritized list of steps taken to avoid hematuria apparition or its worsening, to assess whether a catheter is blocked, and the actions are taken to restore catheter patency for continuous bladder irrigation.

**Bleeding prevention**

The first step is always the prevention of the condition, there are few possibilities to avoid urgent admissions for hematuria, but it is possible to diminish iatrogenic cases caused by healthcare professionals due to improper catheterization or “ex-vacuo” hematuria. Traumatic catheterization, false passages and filling of the balloon inside the urethra are three frequent causes of hematuria and urethrorrhagia which may be avoided taking care of some details as proper lubrication, use of the correct catheter choosing Coudé tips if difficult catheterization is suspected. In the same way, the progressive emptiness of the bladder in cases of acute retention, with not emptied volume over 1 liter, easily avoid the appearance of “ex-vacuo” hematuria. However, the main way to avoid severe and complicated hematuria is on urologist's hands. The surgical technique during TURB, TURP and open prostatectomy have to focus achieving the best possible hemostasis. After these surgeries, there may be venous or arterial bleeding; the former is not so important because usually stops just with a compression made with the catheter balloon. In the opposite hand, the arterial bleeding is more difficult to manage in the postoperative period. This problem may be avoided taking time during endoscopic surgery in coagulating any bleeding point at the bladder and prostate. By closing the irritation fluid during surgery, the less important bleeding points may be discovered and coagulated. The bladder neck is a place that must be carefully reviewed because is the entrance of the prostatic ramus of the inferior vesical artery.

In fact, during open surgery, this area has to be properly sutured with Harris stitches at 5 and 7 o’clock positions of the bladder neck (Harris, 1934). However, other urologists prefer to give Silverton’s “U” shape stitches that include areas between 3 to 5 o’clock and between 7 to 9 o’clock (Silverton, 1934). Other two very significant development in the evolution of sutural hemostasis was to separate the prostatic fossa from the bladder neck and to trigonise before capsule closure (Walker, 1938).

A safe usual behavior is to use well sized three ways catheters (commonly 20-22 Fr) with an irrigating fluid running since the minute one because the main bleeding time is the first hours after surgery. Avoiding blood clots formation during this risk period we may assure a better evolution of the whole postoperative period. Moreover, to check that the irrigating fluid color is totally clear before leaving the surgical theater is the best moment to take a decision about needing a surgical review of the hemostasis.

**Evaluation and physical treatment of hematuria**

First of all, we will focus our review on the assessment by nurses of a blocked catheter and their priorities in case of its presence. Most times, this suspicion is due stopping of saline irrigation drip and/or the patient refers to pain. When the catheter output is blocked, the irrigation fluid continues to enter the bladder until the pressure in it equals the hydrostatic pressure of the saline bag. This overfilling of the bladder produces detrusor contractions which are ineffective to empty the bladder and the patient has pain due to bladder spasms. Probably, the main concept to be taken in consideration by healthcare professionals treating hematuria is that catheter obstruction increases bleeding and bleeding worse obstruction in a vicious circle that should be completely broke if we want to solve the problem. To unclog the catheter temporarily, just taking out the clot which is producing the obstruction and leaving in place a huge amount of them in the bladder is a mistake that has to be clearly taught to all personnel involved in its treatment.

In 2001, Cristine Ng et al. published a chart of recommendations of an expert panel to assess a blocked catheter and, once the problem is clearly stated, also published the steps that should be taken to face the situation (Ng C, 2001). We unify and modified both lists and include a couple of specific skills needed to perform all these steps in a complementary section (Table 1).
Table 1: Recommendations to assess a blocked urinary catheter and the steps that should be taken to solve it

<table>
<thead>
<tr>
<th>Step</th>
<th>Recommendation</th>
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<tbody>
<tr>
<td>1.</td>
<td>Check the saline irrigation for remaining volume height of stand and level of fluid in drip container</td>
</tr>
<tr>
<td>2.</td>
<td>Check the drainage bag for amount, color, consistency and position</td>
</tr>
<tr>
<td>3.</td>
<td>Adjust the irrigation tubing clamps to ensure continuous flow rate</td>
</tr>
<tr>
<td>4.</td>
<td>Assess the catheter and the tubing for patency, kinking, traction and leakage</td>
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<td>5.</td>
<td>Check fluid balance/bladder washout chart for signs of urine/washout fluid retention</td>
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<tr>
<td>6.</td>
<td>Percuss and/or palpate patient´s bladder</td>
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<tr>
<td>7.</td>
<td>Ascertain patient´s degree of discomfort by asking its feeling between 1 to 10, compare con previous rating and take into account if the patient has spinal anesthesia or IV pump of analgesics</td>
</tr>
<tr>
<td>8.</td>
<td>Consider the size and consistency of the current indwelling catheter</td>
</tr>
<tr>
<td>9.</td>
<td>Consider washout of the bladder to unblock the catheter and extract bladder clots</td>
</tr>
<tr>
<td>10.</td>
<td>If bladder washout has to be done, reassure the patient and explain the problem</td>
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<tr>
<td>11.</td>
<td>Turn off the bladder irrigation system to avoid further overfilling of the bladder</td>
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<tr>
<td>12.</td>
<td>Washout the bladder following the technique described in next section until it is clear that there are no more clots inside the bladder</td>
</tr>
<tr>
<td>13.</td>
<td>If the output is heavily bloodstained (like tomato soup) consider apply catheter traction when a prostatic bleeding is suspected (not from bladder mucosa)</td>
</tr>
<tr>
<td>14.</td>
<td>Initiate steps to prevent subsequent clotting ensuring the irrigation flow is at a maximum rate. If the drip container is totally filled, is not possible to see the irrigation flow rhythm, put it upside down and press it to empty it totally or partially, then return it to its usual position</td>
</tr>
<tr>
<td>15.</td>
<td>Reassess patient´s pain level and administer analgesia as required</td>
</tr>
<tr>
<td>16.</td>
<td>If there is any doubt about the complete empty of the bladder clots or if the output is heavily bloodstained (like tomato soup) call the responsible physician to inform about the problem.</td>
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</tbody>
</table>

How to perform a bladder washout in an effective way?

Sometimes hematuria is not so intense to cause big clots and light washouts may be easily performed through a soft 18 Fr Foley catheter. However, on many occasions, there are big organized clots which are really difficult to extract from the bladder. What to do in these cases?

First of all, we should evaluate if the catheter may be safely changed by another more stiff and sized (about 20-22 Fr). If the catheter is too soft, it will collapse with the high negative pressure that we have to apply to the syringe when trying to extract old organized clots. A study performed (Diz R. et al, 2008) comparing the irrigation and drainage capacity of three 22-Fr catheters of different materials, showed that polyvinyl catheters showed significant better inflow and outflow than latex or silicone catheters (p<0.001). Moreover, latex catheter showed a significant outflow decrease with the insufflation of the self-retentive balloon. Finally, lumen size has a capital importance in lavage catheter function. If its size is not wide enough for clot extraction, it will be obstructed many times during washout maneuvers.

However, catheter change is a decision that have to be clearly evaluated. If the patient was recently prostatectomized (open or endoscopically), we take the risk to be unable to pass a new one through the prostatic lumen overpassing the stump of a high bladder neck resulted from the surgical procedure. In these cases, this decision should be taken by a urologist. However, if the hematuria appears after a TURB or the hematuria is not the result of a surgical procedure (hemorrhagic cystitis, anticoagulants...), it is possible to change the catheter safely almost always. Reassure the patient and start passing an IV analgesia. Ask the patient to inform if the procedure is producing too much pain or want to make a temporary stop. If the catheter is adequate for doing washout in good conditions, start emptying the balloon to be able to
move the catheter freely through the bladder. This way it is possible to avoid the existence of a blind area surrounding the balloon that cannot be cleared through the catheter holes which are placed in a superior place respect to the balloon (Fig. 1).

![Image](image1.png)

*Fig. 1: Blind area to bladder washout when balloon is inflated*

Start washout by creating a “security chamber” at the top of the bladder extracting clots with the catheter almost totally introduced into the bladder. In some cases, when washing out the upper part of the bladder, the bladder mucosa makes a kind of beret which block the catheter holes. In this case, a second 60 cc syringe may be injected separating away the bladder wall and avoiding plugging of the probe holes (Fig. 2).

![Image](image2.png)

*Fig. 2: Bladder washout technique step by step. Main washout flow (Green arrow). Catheter movement during clearing clots (Yellow arrow)*

Start the clot extraction with an organized plan. The holes of the probe may be placed in very different ways and not all are equally effective evacuating clots. Lateral holes placed at the same level are more easily obstructed than those place at a different level. Moreover, the frontal hole, not present in all catheters, is the most effective in extracting the clots. In our experience, the whistle tip probe has the best holes configuration for an efficient bladder washout (Fig. 3). When a probe has a whistle configuration over a Coudé tip, the efficiency is even better because it is possible to extract the clots in a programmed way. Start extracting clots with the tip oriented to the front and wash this bladder quarter starting at the top and going down to the bladder neck. Once the syringe does not extract any clot in a couple of times, turn the tip to the right wall and repeat the procedure. Continue the washout at the left quarter and finish extracting clots from the posterior wall.
After significant bleeding, very organized and firm clots are inside the bladder which makes difficult to extract it. In these cases, when suction is performed with the syringe, clots blocks completely the holes of the urethral catheter making impossible to perform a good clot evacuation. When this happens, the best way to solve the problem is to use the “fishing method”. It consists in extracting the urethral catheter, when it is obstructed by a clot, but maintaining the suction to take the clot out the patient; then the catheter is cleaned outside and reintroduced through the urethra. This maneuver may be repeated as many times as are needed to totally extract the clots. The only limitation are post operated patients of the prostate which may have catheterization difficulties. With this protocol, we were able to extract even big organized clots in almost all patients.

If the bleeding is secondary to prostatic surgery, try to move the probe upside down without taking the tip out of the bladder to avoid reinsertion problems. Moreover, in the case of prostatic bleeding, a traction may be done after finishing washout. Performing a traction with the balloon of a catheter is not a guaranteed maneuver. Even been a very effective technique, in some cases, it makes no difference or, in rare cases, may also increase bleeding (Fig. 4).

The readers may ask why it this happens? The answer is related to the capacity of the balloon to press over the bladder neck and collapse the main arterial supply of the prostate. To achieve it we have to fill the balloon between 40 to 75 cc (check the maximum permitted volume) and then make a gentle traction of the catheter until the color diminishes its intensity and fix it to the thigh with tape or using specific adhesives designed for that function. If the balloon is not properly inflated inside the bladder, or the prostatic cavity has a big size,
the balloon will enter into the prostatic lumen when the catheter is pulled, even tearing the tissues of the bladder neck. This will produce more bleeding and will prevent contraction of the prostatic capsule which is a significant component of postoperative hemostasis. It is important to understand that a successful traction, which achieves stop of the bleeding, is not always a synonym of the disappearance of all clots. The balloon avoids the reflux of the blood from the prostatic fossa to the bladder lumen limiting bleeding to this fossa with the consequent clot formation inside it until the bleeding finally stops. Once the patient is not actively bleeding the irrigation may be stopped but the color of the urine will become “coluric” due to the fibrinolysis of the old clots that will dye the urine that will take a “coca-cola” aspect. This is a clinically important situation because it has to be explained to the patient leaving clear that do not represent active bleeding and because the clots inside the prostatic lumen may obstruct the urethra causing acute urinary retention that will distend the bladder and will restart bleeding and appearance of new clots. In these cases, the catheter may be left in place for a week leaving the proteolytic enzymes of the urine to dissolve the clots almost completely. Finally, it must be cleared that when the bleeding is suspected to have its origin in the bladder mucosa there is no sense to perform a catheter traction. There are few alternatives to the classic syringe clot evacuations; Yu HS et al (2011), published a successful evacuation of severe organized clot retention using a catheter connected to wall suction. However, we think that this procedure has to be very painful for the patient and will increase the risk of injure the bladder mucosa during the procedure making posterior bleeding even worse. The only safe and effective alternative to our technique is to perform a bladder washout at the surgical theater under anesthesia by using a resectoscope and Ellick evacuators. This technique is more aggressive, however, permits not only to break the organized clots with an endoscopic loop but also may be used to “burn” the clot which is then attached to the loop permitting to extract big clots attached to it. In some cases, even trained nurses may extract all blood clots and should requested the assistance of a urologist usually by telephone. In these cases, a common language is required to avoid the formation of an unambiguous picture. Failure to communicate effectively may lead to poor patient care with diagnostic errors or delayed treatment and potential liability. However, nurse’s description of the urine color may vary highly depending on their experience with urologic patients. It this context, using a reference color scale and relating it to the irrigation flow is the best way to achieve a clear communication between nurses and urologists avoiding any misunderstanding problem (Lee et al, 2013) (Schneidewind et al, 2014).

**To irrigate or not irrigate, there is any question?**

Post-operative bladder irrigation has been an integral part of surgical procedures on the bladder and prostate and is still widely practiced and recommended in textbooks and journal articles. Bladder irrigation is also the recommended treatment for spontaneous bleeding. However, there are a few groups that continues to put in doubt its advantages and utility. The reasons for using it are: Prevention of clot formation and subsequent urinary retention; flushing out of small clots before they become larger, maintenance of catheter patency and bleeding control. Finally, the temperature of the fluid used for irrigation (about 25°C) is lower than body temperature (about 37°C); this difference produces vasoconstriction of the bladder mucosa reducing bleeding in cases of hemorrhagic cystitis (Mobb et al 1993) (Okorie 2015). In contrast, those who advocate not using it give these opposite reasons: Less workload on the medical staff, less financial cost to the patient, easier calculation of urine output, reduced risk of bladder rupture in cases of a blocked urethral catheter, urethral blockage and clot retention still frequently occur even in the presence of continuous bladder irrigation and avoidance of suprapubic pain/discomfort (Mobb et al 1993) (Okorie 2015).

Seventy years ago, Adams entitled the continuous bladder irrigation as a “third ureter” and this concept still having sense. Some of the proposed disadvantages of not using irrigation are easy to answer (Adams, 1949). A study of patients that were randomized to use continuous irrigation or not (Britton et al, 1992) showed that the group receiving no irrigation required manual bladder washout in 2/3 of the cases; However, the irrigation group required to be manually washed only 1/3 of the patients. Manual washout is much more painful than continuous bladder irrigation in almost all patients. Moreover, a bladder washout, correctly done, consume more time than changing a bag of fluid every 1-2 hours that takes few seconds and may be done not only by nurses but the auxiliary personnel or even the family of the patient.

A 33% difference is a huge difference that tips the scales clearly in favor of the irrigation. Finally,
irrigation fluid costs are really low. A 3 liters bag cost less than 3 euros and, at the maximum flow rate, a bag lasts 1 hour. Even maintaining this high flow rate for 12 hours the final cost represent about 36 euros and will avoid 1/3 of nurse bladder washouts reducing at the same time the postoperative stay.

Last year, Ding et al (2016) presented an automatic regulating device for continuous bladder irrigation with three modules, including a monitor to control the color of drainage output, flushing fluid rate adjusting controller and a computer microprocessor. However, we think that this not necessary to be used because it will be expensive, will require the same fluid bag exchanges and should have automatic stop and sensible alarms of irrigation dysfunction.

It is true that some patients have a bad tolerance for the irrigation; in these cases, use of spasmyotics and reduction of the fluid inflow are usually enough to solve the problem. Calculation of urine output is equally easy to do with or without irrigation. Fluid bags use to contain 3 litters, just a simple subtraction between the total amount of urine minus the irrigation fluid is the truth urine production. Some authors argue that simply increasing the intravenous fluids and using diuretics they may maintain enough output to maintain the urine without clot formation. In our opinion, this is a fallacy in most cases. Patients that are surgically operated of the prostate or the bladder used to be old people who frequently suffer cardiac diseases, renal insufficiency, vascular problems and other conditions. This makes the fluid overcharge plus diuretics a not recommendable strategy for a huge number of patients. Finally, it is true that in case of a blocked urethral catheter, the presence of a continuous irrigation may overfill the bladder increasing the risk of its rupture in cases of bladder resection but not after a prostatic operation with an intact bladder wall.

Medical treatment of hematuria

The etiology of the hematuria also has to be treated. The clearest example is the bleeding due to the excessive effect of oral anticoagulants or antiplatelet medications. Warfarin continues to be the most widely used oral anticoagulant but the use of the newer oral anticoagulants (Dabigatran etexilate, Rivaroxaban and Apixaban) is increasing. In cases of excessive warfarin effect (known by the INR rates > 4.5), oral treatment should be stopped and the anticoagulant effect reversed by using parenteral Vitamin K. For immediate reversal, prothrombin complex concentrates or fresh frozen plasma may be used. Finally, Idarucizumab is the first agent that reverses the anticoagulant effect of anticoagulants that don't block vitamin K. However, its action is more specific against Dabigatan etexilate. In many cases, oral treatment is substituted by low-molecular weight heparins until the problem is solved and then it may be reintiated.

In cases of hemorrhagic cystitis secondary to urinary infection, a simple urine culture has to be initially taken and then initiate a wide spectrum antibiotic treatment. Due to a significative part of urinary infections are resistant to ciprofloxacin, a third or fourth-generation cephalosporins are ideal drugs for an empiric initial treatment. The continuous fluid irrigation is double beneficial in these cases, not only physically eliminates 99% of germs dragging them out of the bladder but also diminish bleeding by causing vasoconstriction of the bladder mucosa.

Another helpful medication to reduce, postoperative or spontaneous, bleeding is Tranexamic acid. It is a synthetic derivative of the amino acid lysine that exerts its antifibrinolytic effect through the reversible blockade of lysine binding sites on plasminogen molecules. Intravenously administered tranexamic acid (most commonly 10 mg/kg followed by infusion of 1 mg/kg/hour) caused significant reductions (30-60%) in postoperative blood losses reducing transfusions requirements. Tranexamic acid doesn't increase the risk of thrombosis and is well tolerated; nausea and diarrhea are the most common adverse events.

In cases of acute actinic cystitis, TRUB coagulation of bleeding points is a common technique. However, in recurrent patients, treatment with hyperbaric oxygen is frequently used achieving a complete and partial response rate in 86.8% and 13.2% of cases respectively (Dellis et al, 2017). Other common treatment for this condition, is bladder instillation with sodium hyaluronate for at least 8 weeks (Martinez et al, 2015). Sommariva et al, (2010) recommend to add, dexamethasone in the first 4 weeks to increase success results without incurring side effects.

Trying to avoid endoscopic evacuation under anesthesia of high burden or organized blood clots, some experimental treatments have been described to facilitate its removal, as hydrogen peroxide (Warlick et al, 2008) or chymotrypsin (Bo et al, 2014), have been published. An 86% of success extracting clots was published by irrigating the bladder with 40,000 U chymotrypsin in 50 mL of 5% sodium bicarbonate using a Foley catheter (20-24 Fr) for 30 minutes. The clots were then easily mobilized and evacuated using continuous saline irrigation and suction with a 60-mL
syringe. The procedure was repeated 2–4 times until all the blood clots had been evacuated. Finally, in cases of intractable hematuria due to bladder cancers, various options are available to manage it (Abt et al., 2013). These include orally administered epsilon-aminocaproic acid, intravesical formalin, alum or prostaglandin irrigation, hydrostatic pressure radiotherapy, urinary diversion, arterial embolization and mitoxantrone perfusion. These treatment options are associated with different prospects of success, risks and side-effects.

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