Exercise-induced hematuria

Author: Angelo Mercieri, MD
Section Editor: Richard J Glassock, MD, MACP
Deputy Editor: Albert Q Lam, MD

All topics are updated as new evidence becomes available and our peer review process is complete.

Literature review current through: Aug 2022. | **This topic last updated:** Jul 20, 2021.

INTRODUCTION

Exercise is the one of the many causes of hematuria (increased red blood cells excretion in the urine) (figure 1). Exercise-induced hematuria can be defined as gross or microscopic hematuria that occurs after strenuous exercise and resolves with rest in individuals with no apparent underlying kidney or urinary tract pathology [1].

Issues related to exercise-induced hematuria in otherwise healthy individuals will be reviewed here. Exercise may also worsen hematuria in patients with underlying glomerular disease, such as IgA nephropathy [2,3].

The general evaluation of adults or children with hematuria is discussed separately:

- (See "Etiology and evaluation of hematuria in adults".)
- (See "Evaluation of microscopic hematuria in children".)
- (See "Evaluation of gross hematuria in children".)

ETIOLOGY AND PATHOGENESIS

Hematuria has been described after a variety of forms of exercise [1,4,5]. These include contact sports, such as football and boxing, and noncontact sports, such as long-distance (marathon or endurance) running [6-8], rowing, and swimming. Hematuria appears to be rare with cycling but has been described, even with stationary bike riding (eg, spinning) [9,10].

The frequency with which hematuria occurs with long-distance running was evaluated in a study of 45 male and female participants who competed in an ultra long-distance marathon [6]. After the race, 11 (24 percent) had hematuria. The hematuria disappeared within seven days. A similar incidence (18 percent) was noted in a report of 50 marathon runners who did not have hematuria on prerace samples obtained daily for three days [11].

The rate of increased red cell excretion after long-distance running is higher when defined by more sensitive testing. This was illustrated in a report of 48 participants in a long-distance race [8]. The urinary red cell count increased in 44 and to values above the normal range (8000/mL in centrifuged urine) in 33 (69 percent). These changes would not usually be detectable in routine practice since only five tested positive for blood on the urine dipstick.

Traumatic — Direct trauma to the kidneys and/or bladder may be responsible for the hematuria associated with contact sports such as football and boxing. In addition, trauma to the bladder may occur with long-distance running and rarely with cycling due to the up and down movement of the bladder [6,7,9]. Ecchymoses and frank contusions have been noted on cystoscopy after long-distance running, possibly due to repeated impact of the flaccid wall of the bladder against the bladder base [7,9]. A possible exacerbating factor is a near empty bladder, which increases the likelihood of apposition of the surfaces of the bladder [7]. Bicycling-related hematuria is attributed to the vigorous and repeated collisions of the perineum with the saddle during acrobatic or bumpy rides (bicycle-seat hematuria) [12]. Urinary symptoms associated with bicycle riding exist also in female bicyclists [13]. Among 282 female members of a bicycling club, one third experienced perineal trauma, 19 percent of which were associated with hematuria and dysuria, and 34 percent with perineal numbness. The frequency and the severity of symptoms were related to bicycling exposure as measured in cycling hours and miles [13]. In some cases of cycling-related hematuria, stopping cycling or adjusting the saddle position prevented recurrence [14,15].

The study of 48 participants in a long-distance race cited above used phase contrast microscopy, which is more sensitive than standard microscopy. This study found dysmorphic red cells in all runners, red cell casts in 10, and new proteinuria in 18, all of which are indicative of glomerular bleeding (picture 1A-C) [8]. Most [16] but not all [6] other studies have also found dysmorphic red cells with exercise-induced hematuria. (See "Etiology and evaluation of hematuria in adults", section on 'Red cell morphology'.)

Nontraumatic — Hematuria can occur with participation in noncontact sports such as rowing, swimming, and stationary bike riding (eg, spinning) [1,4,5,10]. Several mechanisms have been proposed in these cases but none has been proved [1]. One such mechanism is renal ischemia due to shunting of blood to exercising muscles [1,5]. Another proposed mechanism is that lactic

acidosis resulting from anaerobic conditions increases glomerular permeability, which allows the passage of erythrocytes into the urine [17].

Another potential cause of nontraumatic exercise-induced hematuria is nutcracker syndrome, which refers to compression of the left renal vein between the aorta and proximal superior mesenteric artery. Nutcracker syndrome can cause both microscopic and gross hematuria, primarily in children and primarily in Asia but also in adults. The hematuria is usually asymptomatic but may be associated with left flank pain. (See "Etiology and evaluation of hematuria in adults" and "Evaluation of microscopic hematuria in children" and "Evaluation of gross hematuria in children".)

Limited data suggest an association between hematuria (with or without left flank pain) and exercise in selected adults with nutcracker syndrome [18-20]. The diagnosis is established by Doppler ultrasonographic assessment of left renal vein diameter and peak velocity or by magnetic resonance angiography or renal venography [18,20,21]. Possible therapies in adults are discussed separately. (See "Etiology and evaluation of hematuria in adults".)

EVALUATION

Regardless of the mechanism, exercise-induced hematuria appears to be a benign condition with no known long-term morbidity. However, exercise-induced hematuria should be considered a diagnosis of exclusion. In addition to the temporal relation of onset following exercise, the hematuria should remit spontaneously within several days to one week [5,6]. If so, further diagnostic testing is not necessary in most patients.

Evaluation for other causes of hematuria is warranted if the hematuria persists well beyond one week of no exercise and may be warranted even with transient hematuria in patients (particularly men) over age 50 years (especially if recurrent) and selected other patients at increased risk for bladder or kidney cancer [22]. (See "Etiology and evaluation of hematuria in adults" and "Epidemiology and risk factors of urothelial (transitional cell) carcinoma of the bladder", section on 'Risk factors' and "Epidemiology, pathology, and pathogenesis of renal cell carcinoma", section on 'Established risk factors'.)

It has been suggested that evaluation for underlying disease is warranted if the hematuria following exercise is not dysmorphic (ie, nonglomerular) [8]. However, this recommendation only applies when the examiner has experience in identifying dysmorphic red cells and preferably has access to phase contrast microscopy.

Exercise-induced gross hematuria should be differentiated from two other potential causes of red to brown urine following exercise: myoglobinuria due to rhabdomyolysis; and march hemoglobinuria, probably resulting from trauma to red cells as they move through the blood vessels on the plantar aspects of the feet [5,23]. Exercise-induced hemolysis may also be seen in patients with alterations in erythrocyte membrane spectrins; it primarily occurs in the early phase of an ultraendurance race due to a relative older cell population [24]. (See "Causes of rhabdomyolysis", section on 'Nontraumatic exertional rhabdomyolysis' and "Non-immune (Coombs-negative) hemolytic anemias in adults", section on 'Foot strike or hand strike'.)

With myoglobinuria or hemoglobinuria, the urine dipstick is positive for heme in the urine supernatant, but hematuria is not seen on microscopic examination of the urine unless there is concurrent hematuria. The approach to patients with red to brown urine is discussed in detail separately. (See "Urinalysis in the diagnosis of kidney disease", section on 'Red to brown urine'.)

SOCIETY GUIDELINE LINKS

Links to society and government-sponsored guidelines from selected countries and regions around the world are provided separately. (See "Society guideline links: Glomerular disease in adults".)

INFORMATION FOR PATIENTS

UpToDate offers two types of patient education materials, "The Basics" and "Beyond the Basics." The Basics patient education pieces are written in plain language, at the 5th to 6th grade reading level, and they answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials. Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are written at the 10th to 12th grade reading level and are best for patients who want in-depth information and are comfortable with some medical jargon.

Here are the patient education articles that are relevant to this topic. We encourage you to print or e-mail these topics to your patients. (You can also locate patient education articles on a variety of subjects by searching on "patient info" and the keyword(s) of interest.)

- Basics topic (see "Patient education: Blood in the urine (hematuria) in adults (The Basics)" and "Patient education: Blood in the urine (hematuria) in children (The Basics)")

- Beyond the Basics topics (see "Patient education: Blood in the urine (hematuria) in adults (Beyond the Basics)" and "Patient education: Glomerular disease (Beyond the Basics)")

SUMMARY AND RECOMMENDATIONS

- Exercise-induced hematuria can be defined as gross or microscopic hematuria (increased red cell excretion in the urine) that occurs after strenuous exercise and resolves with rest in individuals with no apparent underlying kidney or urinary tract pathology. It is a benign condition with no known long-term morbidity. (See 'Introduction' above and 'Evaluation' above.)

- Direct trauma to the kidneys and/or bladder may be responsible for hematuria associated with contact sports such as football and boxing. Trauma to the bladder may also occur with long-distance running and cycling. (See 'Traumatic' above.)

- Hematuria that occurs in association with noncontact sports may be explained by nontraumatic mechanisms including renal ischemia due to shunting of blood to exercising muscles and the nutcracker syndrome. (See 'Nontraumatic' above.)

- Evaluation is not warranted in patients under age 50 years who are not at increased risk for bladder or kidney cancer, providing there is a temporal association of hematuria with exercise and spontaneous remission occurs within several days to one week following cessation of exercise. (See 'Evaluation' above.)

- Evaluation for other causes is warranted if the hematuria persists beyond one week of no exercise and may be warranted even with transient hematuria in patients (particularly men) over age 50 years and selected other patients at increased risk for bladder or kidney cancer. (See 'Evaluation' above.)

REFERENCES

1. Jones GR, Newhouse I. Sport-related hematuria: a review. Clin J Sport Med 1997; 7:119.
2. Colasanti G, Banfi G, di Belgiojoso GB, et al. Idiopathic IgA mesangial nephropathy: clinical features. Contrib Nephrol 1984; 40:147.
3. Tomino Y, Sakai H. Exacerbating factors in patients with IgA nephropathy. Semin Nephrol 1987; 7:315.

4. Gambrell RC, Blount BW. Exercised-induced hematuria. Am Fam Physician 1996; 53:905.
5. Abarbanel J, Benet AE, Lask D, Kimche D. Sports hematuria. J Urol 1990; 143:887.
6. Kallmeyer JC, Miller NM. Urinary changes in ultra long-distance marathon runners. Nephron 1993; 64:119.
7. Blacklock NJ. Bladder trauma in the long-distance runner: "10,000 metres haematuria". Br J Urol 1977; 49:129.
8. Fassett RG, Owen JE, Fairley J, et al. Urinary red-cell morphology during exercise. Br Med J (Clin Res Ed) 1982; 285:1455.
9. Albersen M, Mortelmans LJ, Baert JA. Mountainbiker's hematuria: a case report. Eur J Emerg Med 2006; 13:236.
10. Algazy KM. Spinner's hematuria. N Engl J Med 2002; 346:1676.
11. Siegel AJ, Hennekens CH, Solomon HS, Van Boeckel B. Exercise-related hematuria. Findings in a group of marathon runners. JAMA 1979; 241:391.
12. Leibovitch I, Mor Y. The vicious cycling: bicycling related urogenital disorders. Eur Urol 2005; 47:277.
13. LaSalle M, Salimpour P, Adelstein M, et al. Sexual and urinary tract dysfunction in female bicyclists. J Urol 1999; 161:269.
14. Nichols TW Jr. Bicycle-seat hematuria. N Engl J Med 1984; 311:1128.
15. Salcedo JR. Huffy-bike hematuria. N Engl J Med 1986; 315:768.
16. Kincaid-Smith P. Haematuria and exercise-related haematuria. Br Med J (Clin Res Ed) 1982; 285:1595.
17. Bellinghieri G, Savica V, Santoro D. Renal alterations during exercise. J Ren Nutr 2008; 18:158.
18. Mercieri A, Mercieri M, Armanini M, Raiteri M. Exertional haematuria. Lancet 2002; 359:1402.
19. Hanna HE, Santella RN, Zawada ET Jr, Masterson TE. Nutcracker syndrome: an underdiagnosed cause for hematuria? S D J Med 1997; 50:429.
20. Zhang H, Li M, Jin W, et al. The left renal entrapment syndrome: diagnosis and treatment. Ann Vasc Surg 2007; 21:198.
21. Shokeir AA, el-Diasty TA, Ghoneim MA. The nutcracker syndrome: new methods of diagnosis and treatment. Br J Urol 1994; 74:139.
22. Mueller EJ, Thompson IM. Bladder carcinoma presenting as exercise-induced hematuria. Postgrad Med 1988; 84:173.

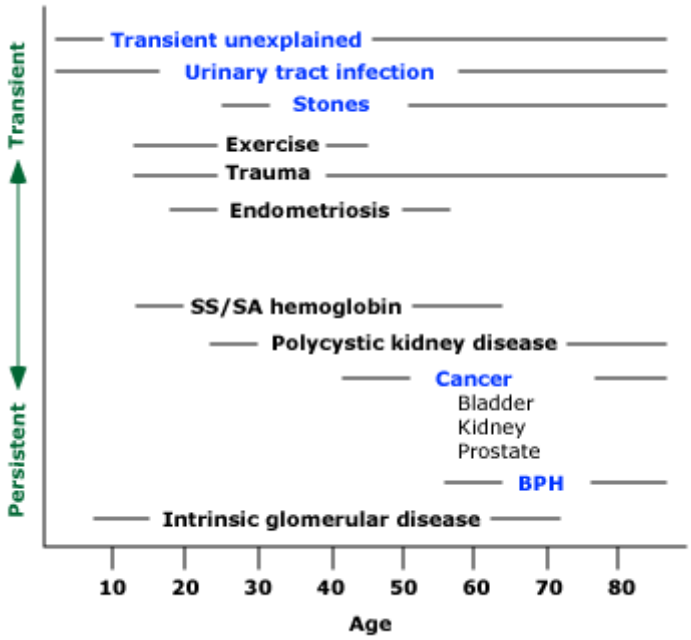
23. Oosterom DL, Betjes MG. [Exertion-related abnormalities in the urine]. Ned Tijdschr Geneeskd 2006; 150:606.

24. Yusof A, Leithauser RM, Roth HJ, et al. Exercise-induced hemolysis is caused by protein modification and most evident during the early phase of an ultraendurance race. J Appl Physiol (1985) 2007; 102:582.

Topic 3109 Version 25.0

GRAPHICS

Major causes of hematuria by age and duration

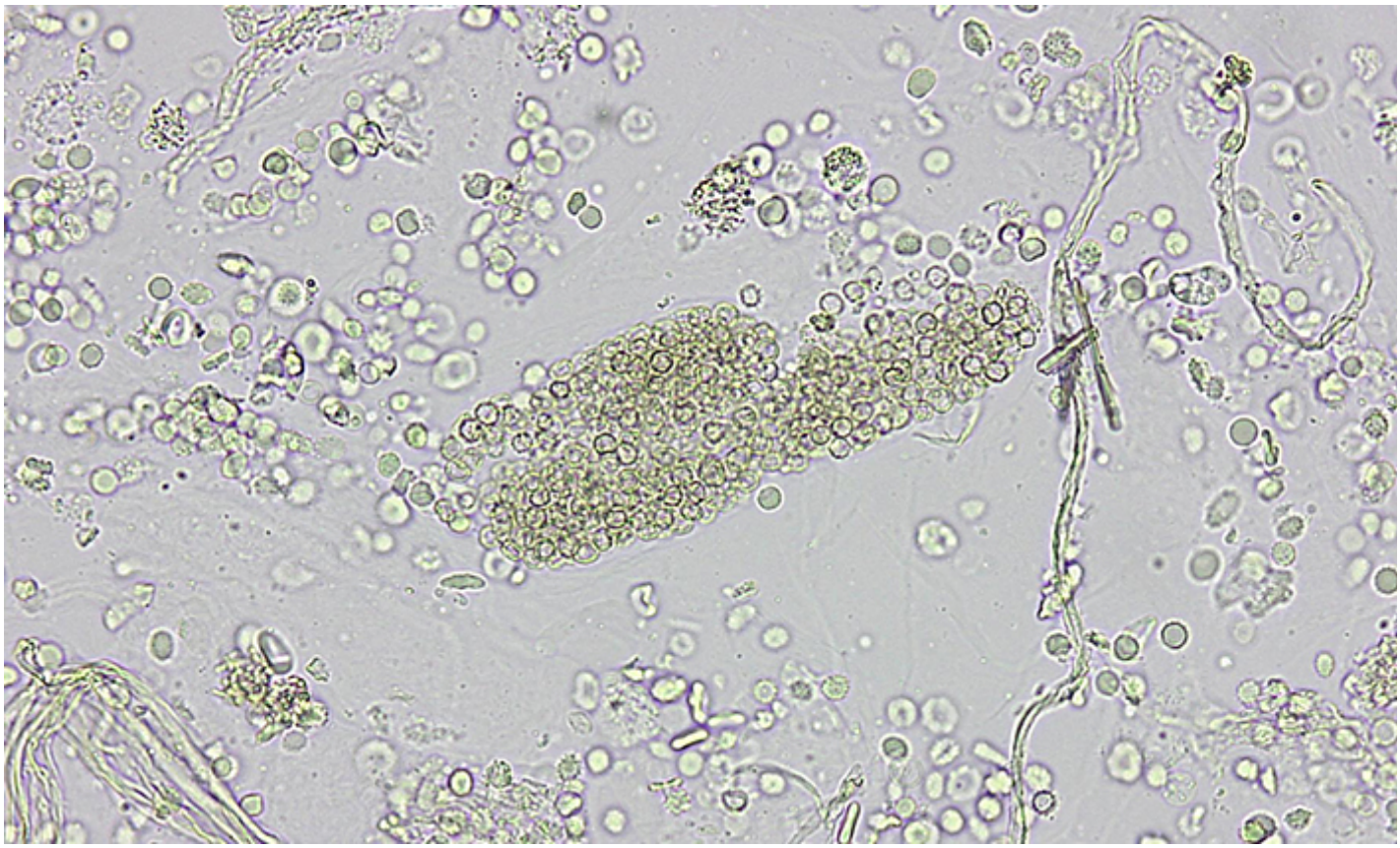


Schematic representation of the major causes of hematuria in relation to the age at which they usually occur (horizontal axis), transience or persistence (vertical axis), and frequency (blue implies more frequent).

BPH: benign prostatic hyperplasia.

Graphic 61296 Version 1.0

Photomicrograph of urine sediment with a red cell cast

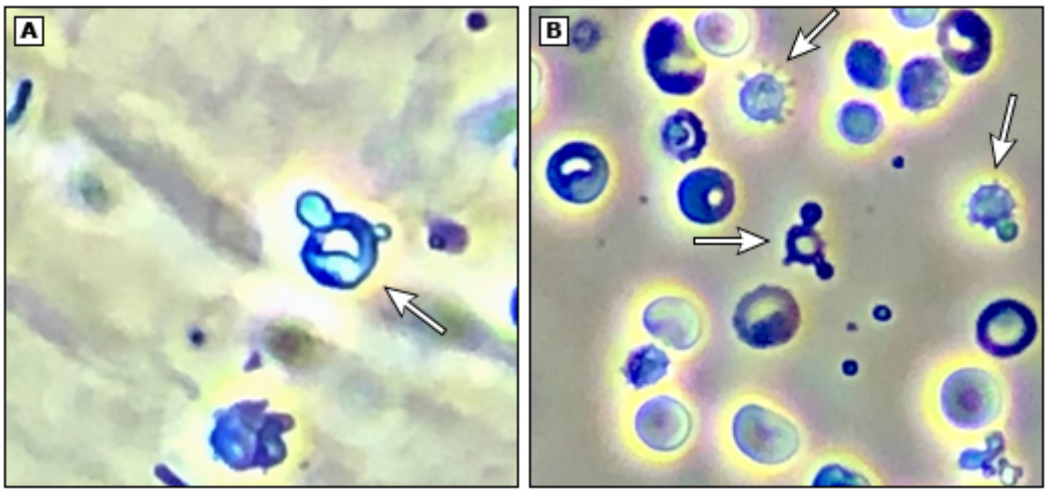


Urine sediment showing free red cells and a red cell cast that is tightly packed with red cells. It is more comr for red cell casts to have fewer red cells trapped within a hyaline or granular cast. Red cell casts are virtually diagnostic of glomerulonephritis or vasculitis.

Courtesy of James F Simon, MD.

Graphic 55778 Version 4.0

Phase-contrast micrograph showing dysmorphic RBCs in urine sediment

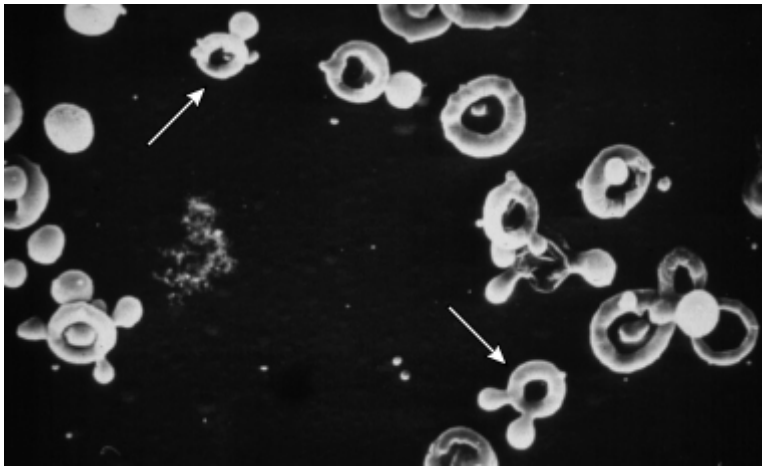


Phase-contrast microscopy showing dysmorphic red blood cells (RBCs) and acanthocytes in the urinary sediment of a patient with glomerular hematuria. Acanthocytes (arrows) can be recognized as ring forms with vesicle-shaped protrusions.

Courtesy of Juan Carlos Q Velez, MD.

Graphic 130438 Version 1.0

Scanning electron micrograph showing dysmorphic red cells in urine sediment



Scanning microscopy showing dysmorphic red cells in a patient with glomerular bleeding. Acanthocytes can be recognized as ring forms with vesicle-shaped protrusions (arrows).

Courtesy of Hans Köhler, MD.

Graphic 62064 Version 3.0

Contributor Disclosures

Angelo Mercieri, MD No relevant financial relationship(s) with ineligible companies to disclose. **Richard J Glassock, MD, MACP** Employment: Karger Publishers [Associate Editor of Nephrology Viewpoints blog for American Journal of Nephrology]. Equity Ownership/Stock Options: Reata [Alport syndrome, pulmonary hypertension, diabetic nephropathy]. Consultant/Advisory Boards: Alexion [Pharmaceutical development]; Arrowhead [Complement-mediated GN]; Aurinia [Voclosporin, lupus nephritis]; BioCryst [IgA nephropathy and C3GN]; Calliditas [IgA nephropathy]; Chinook [Pharmaceutical development]; Equillium Bio [IgA nephropathy, lupus nephritis]; Horizon Pharma [IgA nephropathy]; Ionis [IgA N and anti-PLA2R antibody-associated MN]; National Institutes of Health [NEPTUNE study chair]; Nephro-Sys [Novel agent for GN]; Novartis [IgA nephropathy]; Omeros [IgA nephropathy]; Otsuka Pharmaceuticals [IgA nephropathy]; Renasight [Genetics in kidney disease]; River Renal [R3RE-01 in primary FSGS]; Therini Bio [Novel agent for GN]; Travere [Focal segmental glomerulosclerosis, IgA nephropathy, membranous nephropathy]; Vera pharamaceuticals [Pharmaceutical development]; Vertex Inc [Novel drug compound for treatment of APOL1-related FSGS]. Speaker's Bureau: Aurinia [Lupus nephritis]. Other Financial Interest: American Association of Kidney Patients [Board member; non-profit voluntary health organization]; Oxford Medical Publishers [Primary glomerular disease]; University Kidney Research Organization [Nephrology]. All of the relevant financial relationships listed have been mitigated. **Albert Q Lam, MD** No relevant financial relationship(s) with ineligible companies to disclose.

Contributor disclosures are reviewed for conflicts of interest by the editorial group. When found, these are addressed by vetting through a multi-level review process, and through requirements for references to be provided to support the content. Appropriately referenced content is required of all authors and must conform to UpToDate standards of evidence.

Conflict of interest policy